WATER WORKS & SEWERAGE

Copyright 1940, U. S. Pipe & Foundry Co.

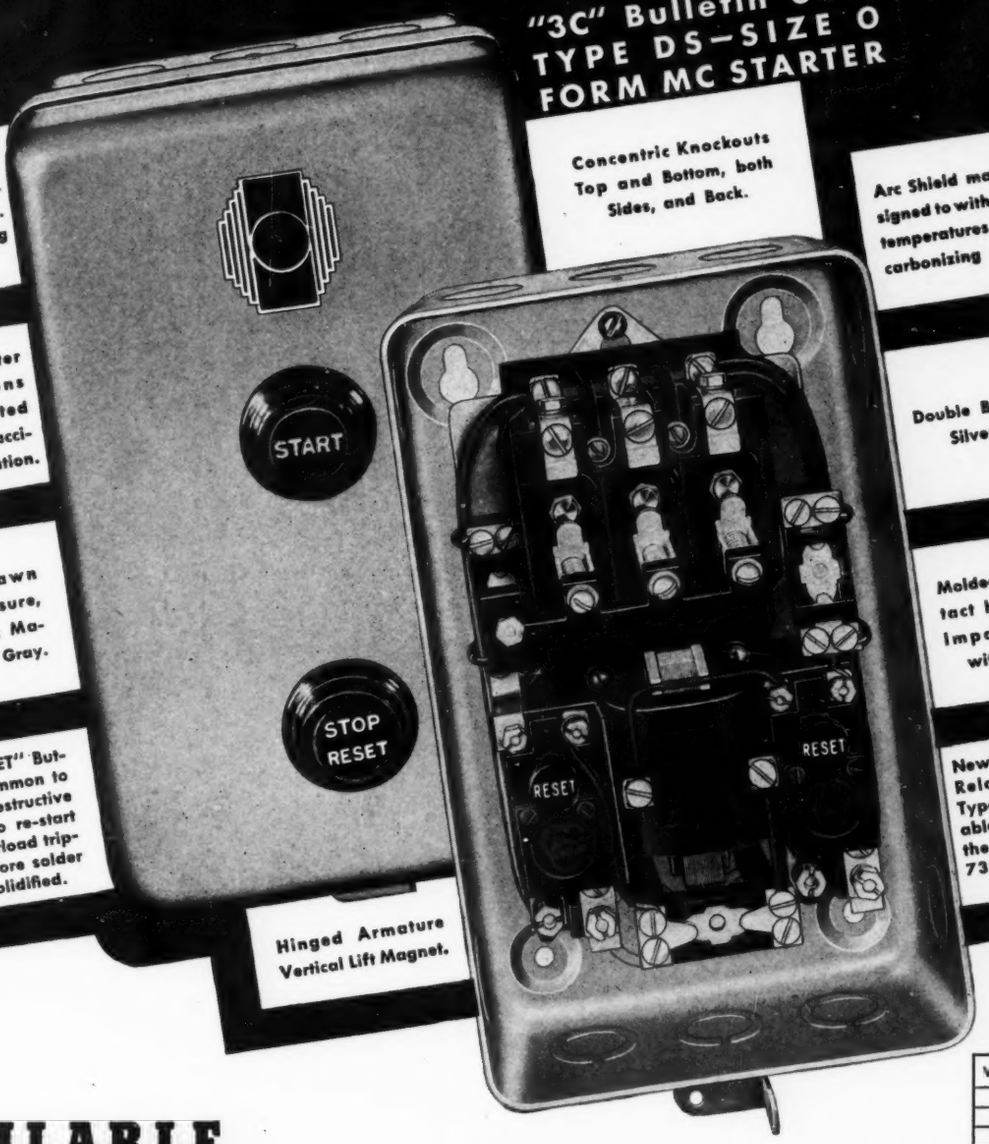
U.S. cast iron PIPE

CAST IRON pit-cast pipe and cast iron Super-deLavaud centrifugally cast pipe are manufactured by this Company in our plants at Burlington, New Jersey; Bessemer and Birmingham, Alabama; and Chattanooga, Tennessee—where large stocks of pipe and standard fittings are available for prompt shipment. Smaller shipments can be made quickly from 14 shipping points throughout the country.

U. S. PIPE AND FOUNDRY CO.
General Offices: Burlington, N. J.
Plants and Sales Offices Throughout the U. S. A.

It's New, and All Set to do a Job!

"3C" Bulletin 6013
TYPE DS—SIZE 0
FORM MC STARTER



Large Electrical and Mechanical Clearances. Plenty of wiring space.

Concentric Knockouts Top and Bottom, both Sides, and Back.

Arc Shield material designed to withstand high temperatures, and is non-carbonizing from arcs.

Large Diameter Push Buttons fully protected to prevent accidental operation.

Double Break Silver to Silver Contacts.

Heavy drawn steel enclosure, finished in Machine Tool Gray.

Molded moving contact holder made of Impact Bakelite to withstand shock.

"STOP-RESET" Buttons are common to prevent destructive attempts to re-start after overload tripping, before solder has solidified.

New Thermal Overload Relay of Solder Pot Type with same desirable characteristics as the very successful Bul. 7322 Thermal Overload Relay.

Hinged Armature Vertical Lift Magnet.

RATING

VOLTS	MAX. H.P. 1 PHASE	MAX. H.P. 3 PHASE
110	1	1½
220	1½	2
440	1½	2
550	1½	2

AVAILABLE

Open or enclosed

With normally open or normally closed control circuit contacts.

In single phase or polyphase types.

In Form MC, with "START" and "STOP-RESET" Button in cover.

In Form MA, with Overload Reset Button in cover. Separate Pilot Device required.

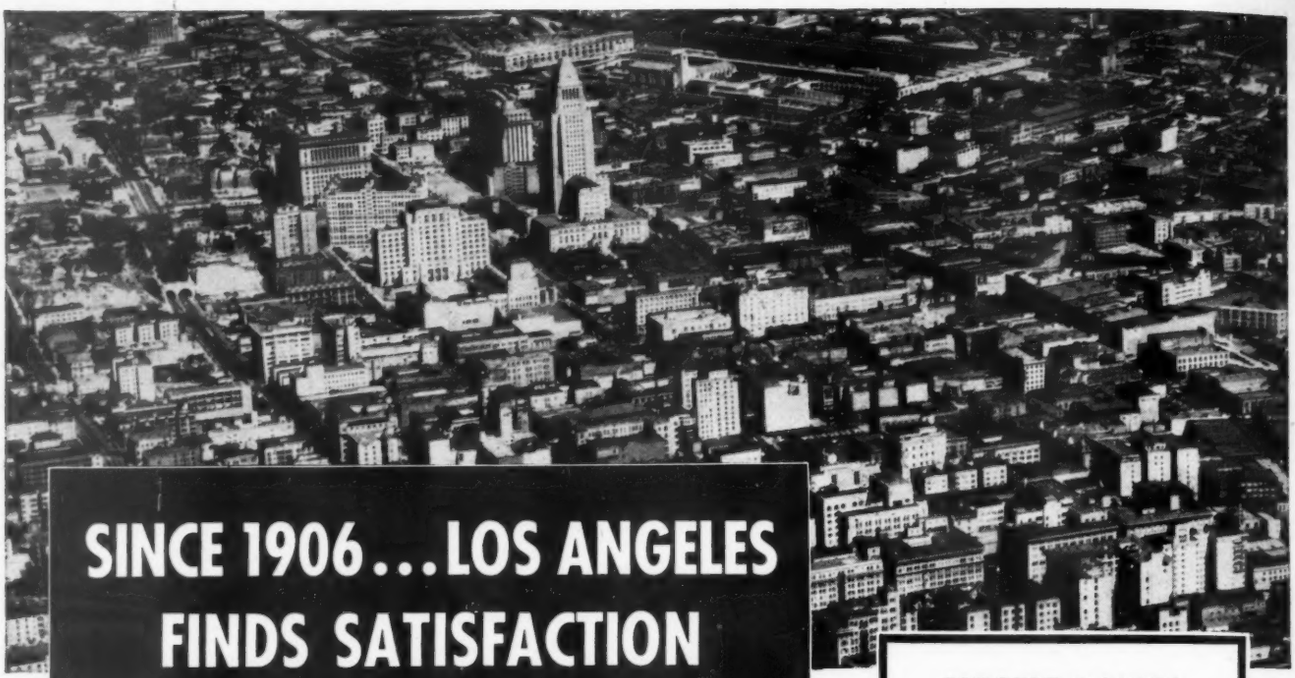
In Form MB, with "MANUAL-OFF-AUTOMATIC" Switch and Reset Button in Cover.

OFFICES IN PRINCIPAL CITIES

THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, OHIO

WATER WORKS & SEWERAGE, May, 1940. Volume 87. Number 5. Published monthly at 330 South Wells Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate. United States and Canada, $2.00 per year; Foreign $3.00 per year. Copyright, 1940. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under Act of March 3, 1879.



SINCE 1906...LOS ANGELES FINDS SATISFACTION IN CRANE VALVES

34 years of TROUBLE-FREE SERVICE proves the economy of PREVENTIVE MAINTENANCE

BECAUSE of the physical characteristics of lower California, the City of Los Angeles water system operates at extremely high pressure. Thus, naturally, extra stamina is looked for in valves.

Back in 1906 when extensions were made, Los Angeles chose Crane 36″ valves. More than 30 years later, the wisdom of this choice is proved. Read what the Chief Engineer of the Los Angeles Bureau of Water Works & Supply recently said: ". . . regarding the Crane valves . . . installed some thirty years ago . . . we have had no trouble of any kind in connection with their operation, except for usual care given to any valve. (Crane valves) meet all requirements . . . are considered very satisfactory."

It was Preventive Maintenance that Los Angeles applied in 1906. It counseled valves that were designed for a specific need—valves whose superior qualities assured economical performance in that service.

Today, every water works and sewage plant can enjoy the full advantages of Preventive Maintenance throughout its system. That's because Crane can supply the right equipment for every operating condition.

Whether you need valves or sluice gates, large or small, you can get them from Crane. You also get sound assurance that in design, in materials, in manufacture as well, they are engineered exactly for the service you require. And there lies the secret of dependable and low-cost flow control.

No matter if your system is large or small, you can't afford to pass up the economy of Preventive Maintenance. Talk it over with your Crane Representative.

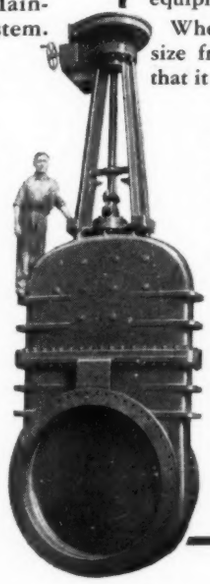
BIGGEST VALVES IN BIGGEST SYSTEMS ARE CRANE VALVES

★

You'll find big Crane valves everywhere—in the nation's largest water works and sewage systems. That's because Crane Quality in big valves is *proved* quality—just as in small and medium size water control equipment.

When you order a valve of any size from Crane, rest assured that it will measure up in every way to your expectations of quality and behavior in service. Its workmanship throughout will be worthy of your confidence, worthy, too, of the name Crane and the greater value it typifies.

For safe, sure, and economical control of your big lines down through the years, Preventive Maintenance counsels big Crane valves. Ask your Crane Representative more about them.



1940 our 85th YEAR

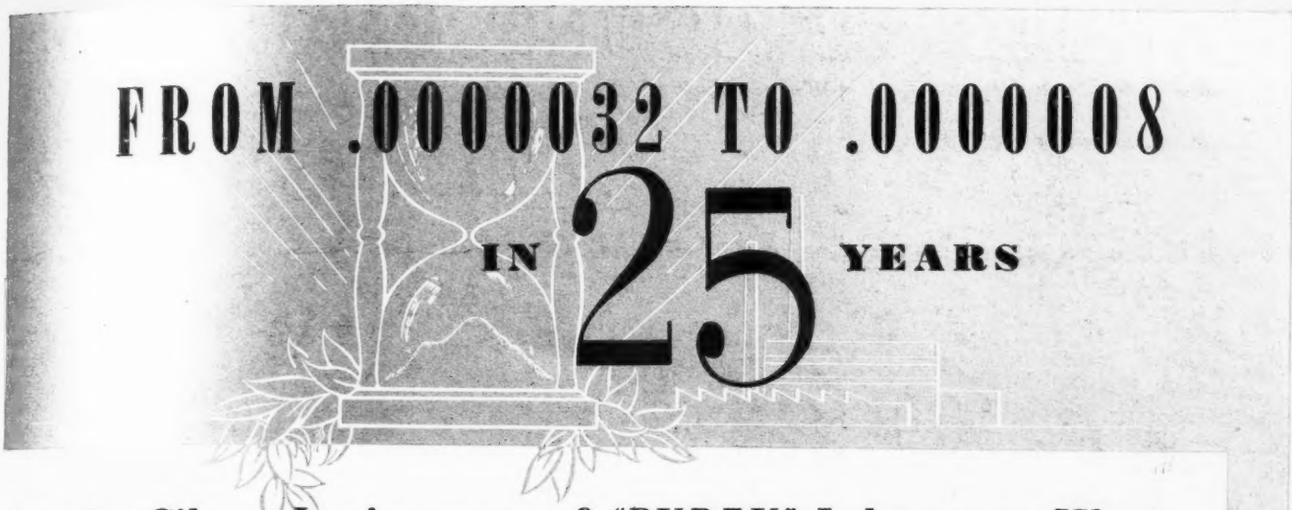
CRANE

CRANE CO., GENERAL OFFICES
836 S. MICHIGAN AVE., CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

FROM .0000032 TO .0000008 IN 25 YEARS



On the Silver Anniversary of "PYREX" Laboratory Ware

Corning Research Announces

"PYREX VYCOR" LABORATORY GLASSWARE

THE NEWEST ACHIEVEMENT IN GLASS MAKING

TWENTY-FIVE YEARS after the introduction of PYREX brand Chemical Glass, Corning Research is able to announce an even greater development —"PYREX VYCOR" High Silica Glass, No. 790.

This new ultra-low-expansion glass has a linear coefficient of .0000008—the lowest of any commercial glass other than fused silica. Its development necessitated a new and revolutionary technique in glass making—the first real departure from that ancient art in 4000 years.

The distinguishing properties of this new glass—exceptional stability, high softening point and very low thermal expansion—make laboratory ware fabricated from it ideal for many applications. For high temperature reactions, rapid chemical analyses or any exceptionally accurate work, this new High Silica glassware will be most useful.

"PYREX VYCOR" Laboratory Glassware is an important supplement to the "PYREX" line. It in no way displaces laboratory ware fabricated from standard PYREX brand Chemical Glass (coefficient of expansion .0000032) which, over the past quarter of a century has proved eminently satisfactory for most laboratory usage.

A limited number of laboratory items in the new High Silica glass will soon be available through your regular laboratory supply dealer. These items, together with a statement of the properties of the glass, will be described in a catalog supplement now in preparation.

Kindly use coupon below.

"PYREX" is a registered trade-mark and indicates manufacture by

CORNING GLASS WORKS • CORNING, N. Y.

THE NEW WARE CAN BE IDENTIFIED BY THIS MARK

"VYCOR" is a trade-mark of Corning Glass Works

CORNING GLASS WORKS • Corning, N. Y., Dept. LW-3
Please send complete information on the new "PYREX VYCOR" Laboratory Glassware.

Name_____
PLEASE PRINT

Address_____

Position_____ Laboratory Supply Dealer_____

CORNING *means* Research in Glass

Pyrex Laboratory Ware
BRAND

NO NEED TO COUNT ON CLAIMS

. . . . *when you can check* ✓

PERFORMANCE!

YOU don't have to depend on "propaganda" in buying activated carbon. Get the *truth* about carbon performance . . . with the Threshold Odor Test, the Carbon Feed Chart, and the Darcograph!

Not only do these three methods tell you which carbon gives maximum removal of tastes and odors . . . but they enable you to check every shipment and make certain of continued dependability.

With these scientific measures, you can prove to your own satisfaction that HYDRODARCO gives best palatability control per dollar.

Start now to buy carbon on the basis of *performance*. Send for instructions on making Threshold Odor Tests. We will also be glad to send you your Darcograph Set and directions for making a Carbon Feed Chart.

Hydrodarco Reg. U. S. Pat. Off.

HYDRODARCO

Hydrodarco, the activated carbon specially made for water treatment, is now packed in new-style bags sealed and taped with Latex tape, to prevent sifting.

DARCO

DARCO CORPORATION

60 East 42nd Street New York, N. Y.

Distributing Points

NEW YORK • BUFFALO
CINCINNATI • CHICAGO
ST. LOUIS • KANSAS CITY
SAN FRANCISCO
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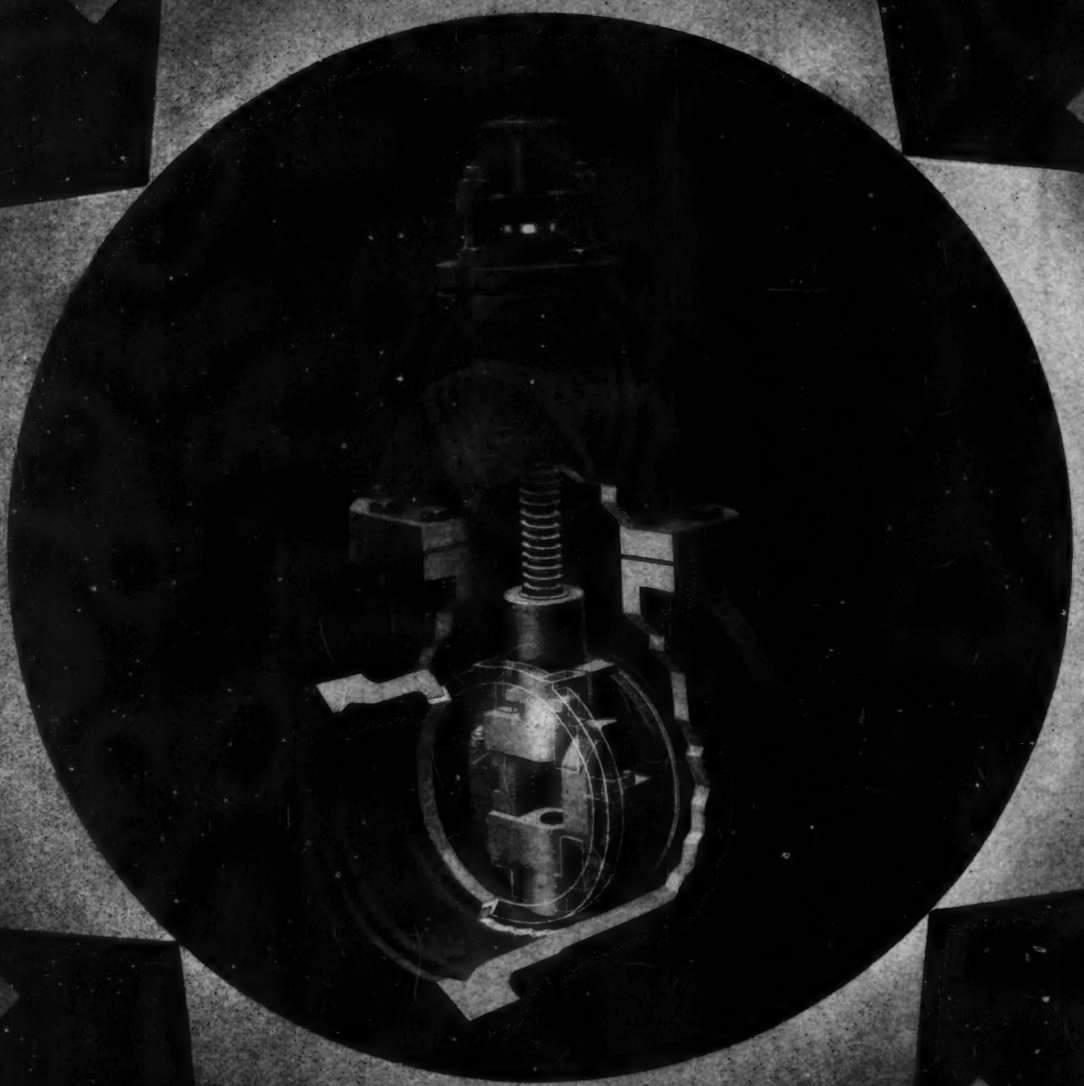
• MARSHALL, TEXAS •

4-POINT CONTACT



Mueller Co. Calent-the parallel seat, double disc Gate Valves use the FOUR-POINT CONTACT principle of wedging action against the valve seat. Complete or positive shut-off is assured by the wedging action of the discs against the seats. Easy to operate. Long life.

MUELLER CO.

FAST INSTALLATION at low cost featured this Transite sewer line at Pearl River, N. Y. Because of Transite's light weight and long lengths, 18" gravity lines were easily and accurately laid. *Sanborn & Bogert, Engineers. Kuchar Bros.* and *Pepper Bros., Contractors.*

Elimination of concrete cradle, unusually rapid installation and tight joints effect important savings on this Transite sewer line at Pearl River, N. Y.

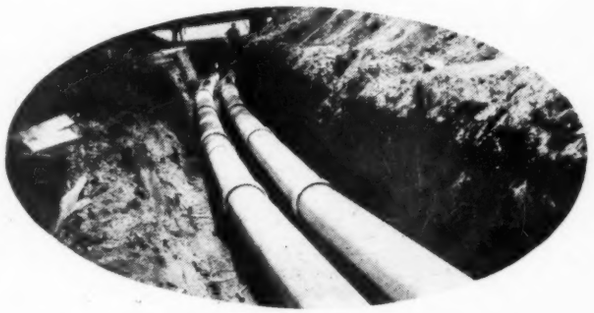
TRENCHES up to 26 feet in depth . . . four siphons in the main trunk line, two of which were over 2400 feet long . . . these were two of many unusual conditions on the Pearl River sewer line.

To meet these requirements, Sanborn & Bogert, Engineers, selected 18,000 feet of J-M Transite Pipe. Because of its uniform strength and durability, this modern pipe safely withstands the weight of heavy backfill *without a concrete cradle!*

On the 18" gravity line, Transite's relatively light weight and long 13-foot lengths made possible a fast, accurate laying job under exacting conditions. On siphons, where the contractors originally hoped to install 500 feet per day, they actually laid as much as *3200 feet of 14" Transite Pipe in one day.*

But installation savings aren't the whole story of Transite Pipe. Made of asbestos and cement, it is highly resistant to all forms of corrosion. Maintenance is practically zero. Joints are tight to begin with . . . and they *stay* tight. And Transite's smooth interior surface (n=.010) frequently makes possible flatter grades, shallower trenches or smaller pipe without sacrifice of carrying capacity.

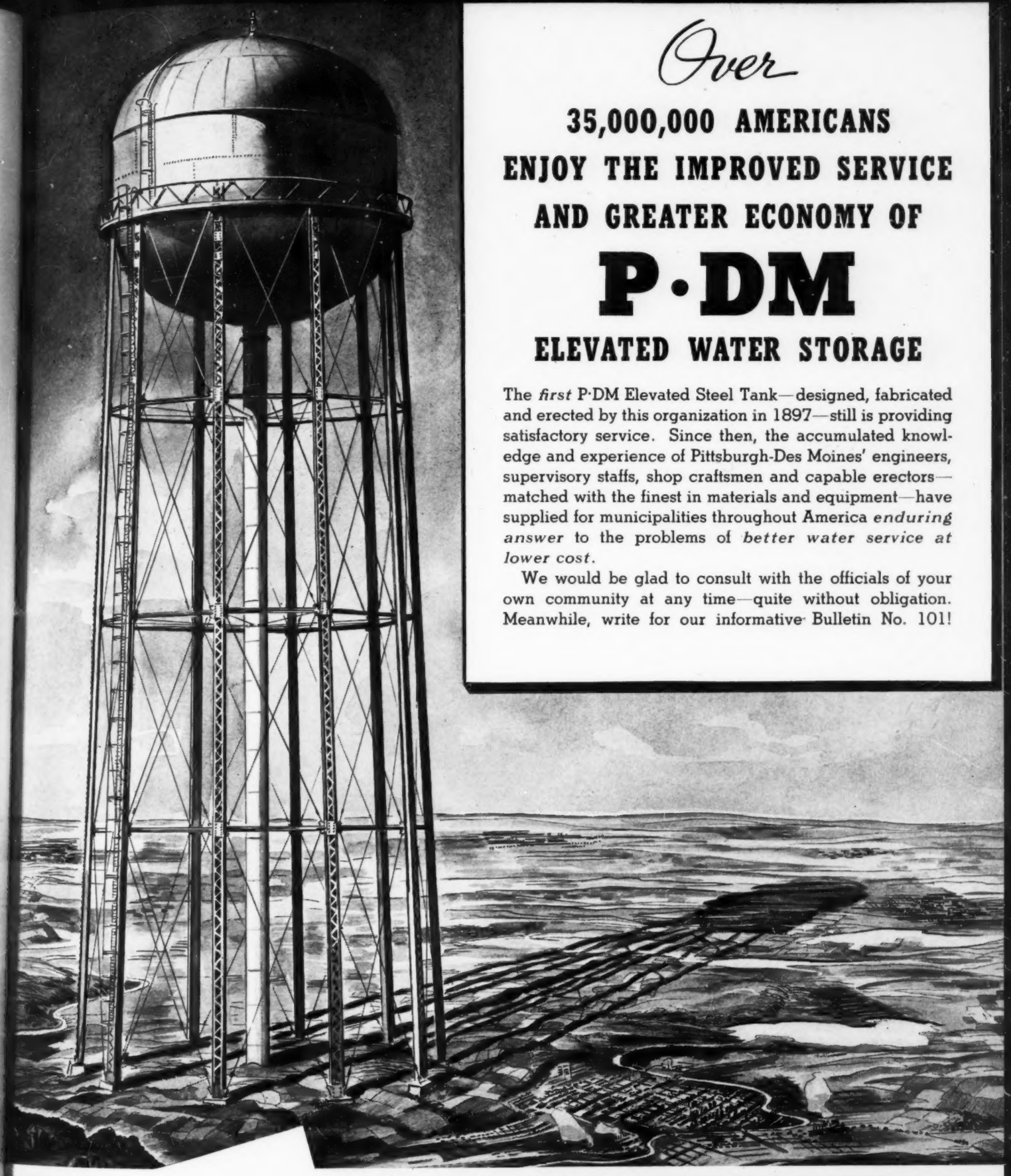
If you are planning new sewer lines or extensions to your present system, why not get the facts on this modern sewer pipe? Write for brochure TR-21A. And for facts on Transite Pipe for better water lines, send for brochure TR-11A. Johns-Manville, 22 East 40th Street, New York, N. Y.



ONE OF FOUR inverted siphon sections in the Pearl River sewer system. Using 14" Transite Pressure Pipe with Simplex Couplings, Pepper Bros., Contractors, were able to lay more than 3200 feet of pipe in one day.

JOHNS-MANVILLE TRANSITE PIPE

The MODERN Material for Sewer and Water Lines



Over

35,000,000 AMERICANS ENJOY THE IMPROVED SERVICE AND GREATER ECONOMY OF

P·DM

ELEVATED WATER STORAGE

The *first* P·DM Elevated Steel Tank—designed, fabricated and erected by this organization in 1897—still is providing satisfactory service. Since then, the accumulated knowledge and experience of Pittsburgh-Des Moines' engineers, supervisory staffs, shop craftsmen and capable erectors—matched with the finest in materials and equipment—have supplied for municipalities throughout America *enduring answer* to the problems of *better water service at lower cost*.

We would be glad to consult with the officials of your own community at any time—quite without obligation. Meanwhile, write for our informative Bulletin No. 101!

P·DM ALWAYS ON THE JOB

PITTSBURGH·DES MOINES STEEL COMPANY

PITTSBURGH, PA. 3418 NEVILLE ISLAND . . . DES MOINES, IA. 919 TUTTLE STREET

NEW YORK, ROOM 918, 270 BROADWAY . . . CHICAGO, 1222 FIRST NATIONAL BANK BUILDING

DALLAS, 1223 PRAETORIAN BUILDING . . . SAN FRANCISCO, 625 RIALTO BUILDING

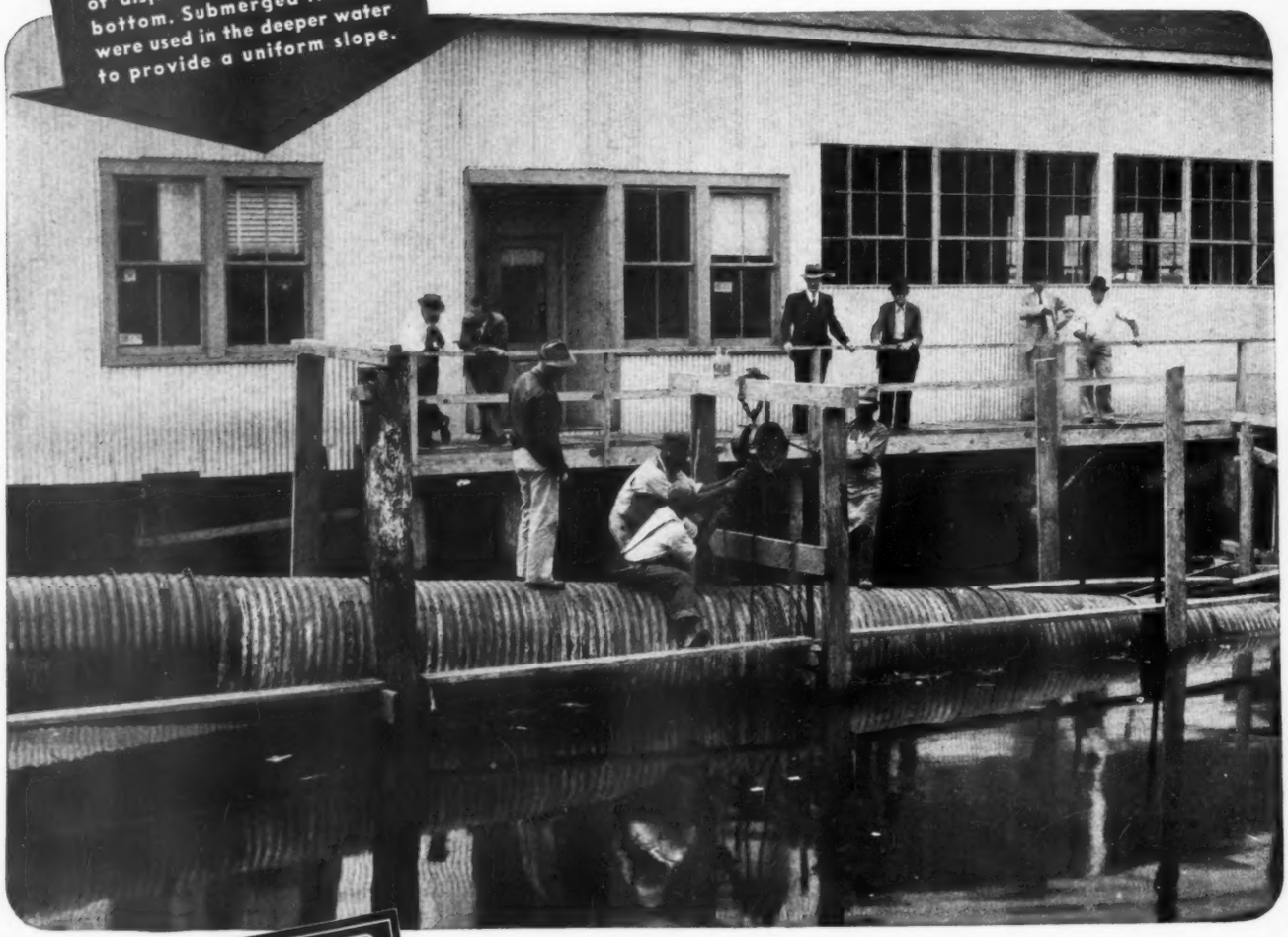
Sewer Troubles Vanish

WHEN YOU USE THIS PIPE

• Why worry about those difficult sewer conditions? You can install Asbestos-Bonded ARMCO Sewer Pipe and forget them. This durable pipe gives you *extra* protection against corrosion or erosion and has adequate strength to safely meet every sewer requirement.

Shifting soils or unstable foundations will never disjoint an ARMCO sewer. Sturdy band couplers see to that by producing a continuous conduit of balanced strength and design. Joints can be made soil- and water-proof. What's more, because of its flexible corrugated metal design, you can install ARMCO Pipe in deep trenches or under shallow cover without fear of crushing or breaking. Material durability is assured by a smooth bituminous pavement that guards the bottom against erosion and a full coating of the same material for protection against acid, alkalies and gases. Lasting adhesion of the bituminous coating is made possible by ARMCO's exclusive Asbestos-Bonding process.

Set your mind at rest on that next tough sewer job by specifying Asbestos-Bonded ARMCO Pipe. Then you'll be protected. And remember, that with all its advantages, ARMCO Pipe usually costs less in the long run. Write us for facts. Armco Drainage Products Association, 5028 Curtis St., Middletown, O.



Down to Davy Jones locker goes this 36-inch Asbestos-Bonded ARMCO outfall sewer. Strong, tight joints prevent sand from entering to clog the line and eliminate the danger of disjointing on the shifting bottom. Submerged trestles were used in the deeper water to provide a uniform slope.

ARMCO

ASBESTOS-BONDED

ARMCO SEWER PIPE

REPORTER: That's a feather in your cap!

FIREMAN: Tell it to the superintendent! He knows how to choose equipment.

"How do you mean?"

"Well, he gets 'em to buy with an eye on the things that count. Take our hydrants, for example — they're Ludlows, all along the line. That means that besides giving us perfect performance, they're easy to inspect and service — no unscrewing anything below ground level, and all the works can be taken out just by lifting the stem up through the barrel. So we inspect and service them often and well. With all hydrants always in order, it's no wonder our fire losses are low."

LUDLOW HYDRANTS

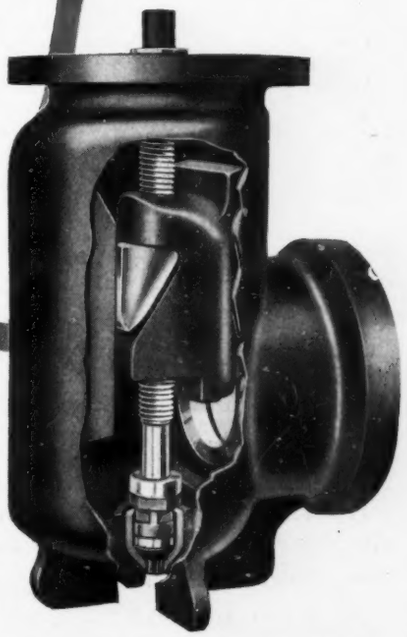
The slide gate principle, developed and perfected by Ludlow, insures *complete security* in fire hydrants. It provides *all* these advantages:

Quick Water with least possible shock. Proper shut-off without water hammer.

Proper Drainage. Hydrant automatically drained at *lowest* point when closed.

No Flooding. Accidental breaking of the hydrant, such as might result by collision from a heavy truck, will not cause flood since the gate when closed is wedge-locked.

Easy Inspection and Servicing without unscrewing anything below the ground level. All working parts removed as one unit by lifting stem through top of hydrant.



NON-CLOGGING DRAINAGE

Closure of hydrant automatically opens this drain, which is located at the lowest point. It remains open until automatically closed by the action of opening the hydrant.

Ludlow Valves

The parallel seat, double wedge type slide gate valve, developed and perfected by Ludlow, has been the universally accepted construction in all waterworks valves for nearly three-quarters of a century. It provides *all* these essential benefits:

Smooth, Positive Operation. Gates positioned *directly* opposite ports before wedging, and entirely unwedged *before* being raised.

Positive Closure — even after years of service in the open position; flexible-action gates *self-adjusting* to seats.

Self-Cleaning. Rings cleaned *throughout entire stroke.* No *internal guides* to cause foul-up.

Ready Replacement of Parts. Simple construction and ample tolerances make possible ready replacement of parts.

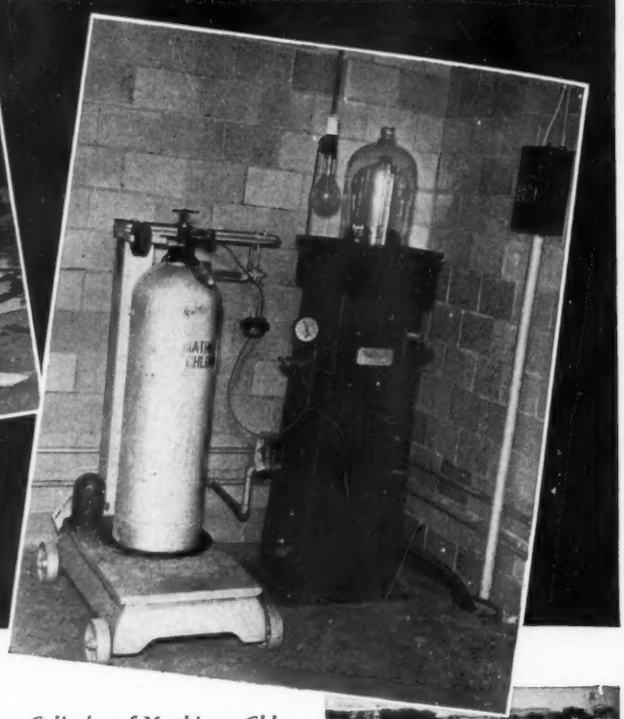
The LUDLOW VALVE MFG·CO·INC· SINCE 1866 TROY·N·Y·

FAMOUS TOWN OF HERSHEY, PA.

Maintains Sanitation

THE MATHIESON WAY

General view of Hershey Sewage Plant. Settling tanks in foreground—drying beds at right.

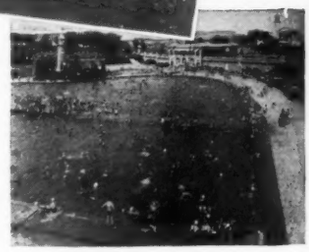


Cylinder of Mathieson Chlorine attached to chlorinator.

● Hershey, Pa., famed for its cleanliness and fine living conditions, uses Mathieson Chlorine to maintain thoroughly sanitary conditions in swimming pool, municipal water works and sewage plants. And Hershey is only one of hundreds of towns and cities that find Mathieson sanitation service efficient and dependable.

In Mathieson Chlorine you are assured of a pure product, trouble-free containers and valves, prompt delivery service. Keep Mathieson HTH on hand, too, for quick, efficient service when water mains break or other emergencies arise.

Be prepared with HTH for any emergency. Write or wire us for full information and your nearest source of supply.



Large swimming pool in Amusement Park of Hershey.

HTH comes in 5-lb. cans with replaceable caps, packed 9 cans to the case; also in 75-lb. drums.

THE Mathieson Alkali Works (INC)

60 EAST 42ND STREET, NEW YORK, N. Y.

LIQUID CHLORINE . . . HTH . . . SODA ASH . . . CAUSTIC SODA . . . BLEACHING POWDER . . . BICARBONATE OF SODA . . . AMMONIA, ANHYDROUS and AQUA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . CARBONIC GAS

Why STEEL MAINS Cost Less!

. . . IN LAYING

Steel water mains cost less to lay because steel pipe weighs less and is easily handled, comes in longer lengths, is readily joined, and requires fewer joints per mile. You can use narrower trenches, because joints on steel pipe can be made in less space.

. . . IN OPERATION

Steel water mains cost less to operate because they retain full carrying capacity for longer time. Keeping tuberculation to a minimum keeps pumping costs lower, saves money ordinarily spent for periodic cleaning of mains. The use of steel pipe reduces leakage and the usual anticipated loss per mile common to other materials.

. . . IN MAINTENANCE

Steel water mains cut repair bills and prevent property damage, because they are not subject to sudden breaks. Steel is strong and ductile—not brittle. You can bend it severely without breaking it. That's why steel pipe withstands earth settlement, shock, vibration — without damage. It's this ability of steel pipe to "stay put" in the trench in spite of unpredictable stresses that eliminates costly maintenance.

. . .

NOW write for more information on NATIONAL Steel Pipe for Water Mains. The National organization, world's largest makers of tubular products, is equipped to serve you efficiently, speedily, and in exact accordance with your requirements.

• *FOR HIGHLY CORROSIVE WATERS*

In addition to regular steel pipe, National produces a special cement-lined pipe, "DUROLINE," designed to give long service under extremely corrosive water conditions. In DUROLINE, the interior surface of the pipe is completely sealed against corrosion—giving you the perfect combination of the strength of steel and corrosion prevention at nominal cost.

• *FOR HIGH WATER PRESSURES*

For handling abnormally high water pressures, we recommend NATIONAL Seamless Pipe, a pipe that is made without welds, by piercing solid billets of highest quality steel. This pipe removes all possibility of localized weakness and assures full wall strength throughout. NATIONAL Seamless is available in sizes up to 24-inch O.D. Write for data.

WALLS WITHOUT WELDS

COPYRIGHT 1939

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* • United States Steel Export Company, New York

UNITED STATES STEEL

PROBLEM

Filter Plant Needed. Make Recommendations.

DESIRED FEATURES:

1. Steel construction to prevent seepage or cracking.
2. Plant to occupy small ground space per unit of capacity.
3. Should be able to add additional capacity easily and economically.
4. Modern, flexible operation. Rapid sand type filter beds. Filters and basins to operate independent of each other.
5. Low operating cost and economical in first cost.

SOLUTION

Use the Morse Filter Plant.

Analysis of its qualifications shows that it checks with all of the points listed above.

1. ✓
2. ✓
3. ✓
4. ✓
5. ✓

The Modern Solution to Municipal and Industrial Water Filtration Problems

The MORSE FILTER PLANT

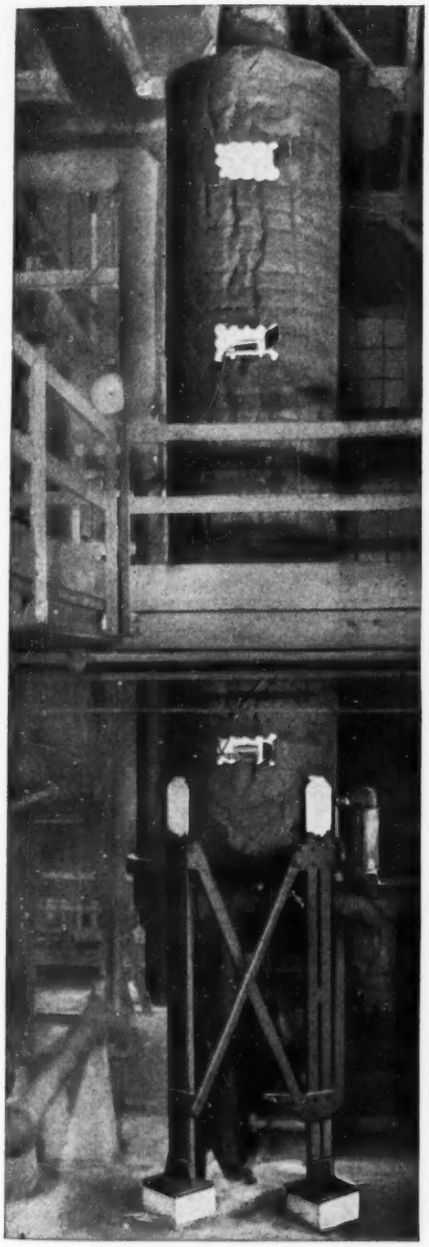
Mr. WATERWORKS ENGINEER: The Morse Filter Plant is designed to meet your individual specifications for modern, efficient and economical water filtration requirements. The unit shown above is at Shillington, Pa., where it serves 2,000 industrial, commercial and domestic consumers in four communities. It has a capacity of 864,000 g.p.d. and is used primarily to correct algae, taste and odor, color and turbidity conditions present in the water supply. An adjacent 300,000-gal. clear water reservoir of steel construction is used. The plant operates approximately 10 hours to supply the daily requirements at the system. Please address our nearest office for complete information or estimating data.

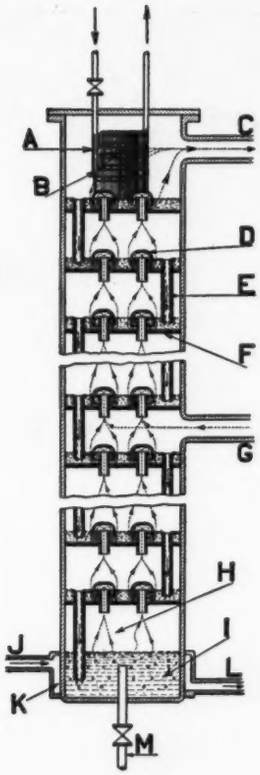
CHICAGO BRIDGE & IRON COMPANY

Chicago.....2198 McCormick Bldg.	Birmingham...1586 North 50th Street	Philadelphia....1644-1700 Walnut St.
New York...3390-165 Broadway Bldg.	Tulsa.....1646 Hunt Bldg.	Boston...1548 Consolidated Gas Bldg.
Cleveland.....2262 Rockefeller Bldg.	Houston.....2919 Main Street	San Francisco.....1083 Rialto Bldg.
Dallas.....1479 Liberty Bank Bldg.	Detroit.....1551 Lafayette Bldg.	Los Angeles.....1455 Wm. Fox Bldg.

Plants at **BIRMINGHAM, CHICAGO, and GREENVILLE, PA.**
In Canada: **HORTON STEEL WORKS, LIMITED, FORT ERIE, ONTARIO**

By this device...





A. Refrigerating Coil
B. Condensing purified chlorine
C. Purified chlorine outlet
D. Bubble cap
E. Downtake for reflux
F. Tray or plate
G. Raw chlorine inlet
H. Chloroform vapors
I. Chloroform and dissolved impurities
J. Steam inlet
K. Heating jacket
L. Condensed water
M. Drain for impurities

Operating Diagram of the Chlorine Fractionating Column

...we have reduced our LIQUID CHLORINE impurities by 95%

Before we designed the fractionating column shown here the purity of our Liquid Chlorine was high. It was, indeed, as high as possible with former techniques. But—appreciating the crucial importance of trouble-free chlorine to water systems, we have met that challenge with this fractionating column. *Now*, from an already highly pure Liquid Chlorine, 95% of that relatively little impurity is being successfully removed—the nearest approach to absolute chlorine purity yet achieved.

For the technically-minded we have prepared a detailed and scientific explanation of the process. A copy will be sent you on request. Pennsylvania Salt Manufacturing Company, Widener Building, Philadelphia, Pa.—New York • Chicago • St. Louis • Pittsburgh • Tacoma • Wyandotte.

PENNSYLVANIA SALT MANUFACTURING COMPANY

Chemicals

TUCSON, ARIZ. One of hundreds of American communities where thousands of feet of Johns-Manville Transite Pipe are keeping water-transportation costs low . . . efficiency high.

YONKERS, N. Y. No large bell holes are needed at joints when J-M Transite Pipe is installed. This means that trenches can be narrower and more economical and that damage to pavements is minimized.

IPSWICH, MASS. Transite's asbestos-cement composition provides exceptional resistance to all forms of corrosive action . . . assures long life and low maintenance, even when laid in acid or alkaline soils.

FOR BETTER WATER LINES—

Hundreds of American communities enjoy the benefits of lower water-carrying costs with J-M Transite Pipe. Check the advantages this better water carrier brings to your system:

You Finish Jobs Faster! Long, 13-foot lengths of Transite Pipe are light in weight . . . transported to the job at low cost . . . easily handled by installation crews. Flexible Simplex Couplings speed up assembly, even under difficult trench conditions. And, because they require no caulking and eliminate the need for large bell holes, they permit the use of narrower, more economical trenches.

You Spend Less on Maintenance! Made of asbestos and cement, J-M Transite Pipe is highly resistant to all forms of corrosion . . . completely immune to electrolysis. Its great durability and uniform strength safely withstand heavy earth loads and traffic pressure. And Simplex Couplings assure joints that *stay* tight . . . provide maximum protection against costly water loss.

You Can Forget Tuberculation! Pumping costs remain at low figures, because Transite Pipe has a smooth interior surface that *stays* smooth in service. Its

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville TRANSITE

BROOKFIELD, ILL. On the job, crews can lay J-M Transite Pipe as fast as the trench is opened. Transite's long lengths and simple, rapid assembly method assure unusually low installation costs.

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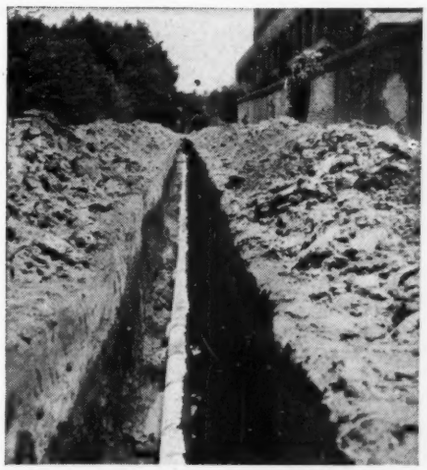

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155 East 44th Street, New York, N. Y.
L. H. Enslow, Editor

COMING!

"The Treatment Plant of Dallas, Texas"

Is to be featured in our June issue. Built at a cost of $1,535,000 this important Southern plant, designed to cope with a high loading of industrial wastes, incorporates preliminary odor control and grease separation by employing "aero-chlorination" in a novel manner. Incorporated in the design are many other distinctive features which render the coming article of exceptional interest. One of these is automatic flow distribution to settling units and the 16 unit battery of 176 ft. diameter revolving-distributor trickling filters. The largest installation of its kind kind in America, these trickling filters are designed to operate as two stage bio-filtration units at will, with or without effluent recirculation in either of the optional procedures. With flexibility, and assured operating efficiency at minimum cost as the objectives, the Dallas designers can be commended. Toward this end we feel that their article warrants featuring in our June issue.

The author—

R. M. DIXON, Designing Engineer
Dep't. of Public Works, Dallas, Tex.

"Results With the Palmer 'Filter-Sweep' During a Year of Operation"

Is the caption of an article from a wide-awake operator in a progressive Water Company which, on the strength of results from a trial installation of the filter bed scouring "Filter-Sweep," equipped the complete plant of 6 M.G.D. capacity. We consider it the best and most complete story ever written on the effectiveness and economy of efficient filter-bed scouring on an operating scale of such proportions. This article will clear the minds of any who longer question the advantages of clean filter beds that are **kept clean** and the efficacy of the scouring type of low velocity wash for the purpose. If this article fails to "sell" the Palmer "Filter-Sweep," or its equivalent, we shall miss our guess.

The author—

E. C. GOEHRING, Chemical Engineer
Beaver Valley Water Co., Beaver Falls, Pa.

"Maintenance of Sewage Pumping Stations"

Without much fear of being contradicted we can say that this article, dealing with maintenance of sewage pumps and pumping station facilities, is the most complete and definite of any that has ever come to our attention. Written by an operator with high capabilities and a background of experience, this article is one to be studied religiously. It should serve as a maintenance and operation guide for time to come, and readers charged with pumping station operation will find its value grows with each reading.

The author—

A. L. SODEN, Chief Operator
Sewage Pumping Stations, Trenton, N. J.

"The Softening and Filtration Plant of The Metropolitan District of Southern California"

This important plant, with its several innovations in design and operating facilities, is to be described in a series of three articles. The method of softening selected is a combination of lime and zeolite treatment, the peculiar reasons for which are set forth in the first article —"Selection of the Method of Treatment." The second will present "Features of Plant Design" and the third will discuss the feasibility and economics of "Lime Reclamation," which has been carefully studied in connection with this project. The authors—

CHAS. P. HOOVER and
JAS. M. MONTGOMERY
Consulting Engineers, Columbus, Ohio
WM. W. AULTMAN, Engineer
The Metropolitan Water District,
Los Angeles

VOL. 87, NO. 5

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This Month's Cover—Pictures the successful waste treatment plant of Armour and Co. at Fargo, N. D., providing consistently dependable low cost purification of packinghouse wastes. Its several unique features and performance records are recounted in L. R. Howson's article in this issue.

H. P. GILLETTE, President; E. S. GILLETTE, Vice Pres. and Publisher; L. H. ENSLOW, Vice Pres. and Editor; JOHN C. BLACK, Managing Editor; Associate Editors — J. R. BAYLIS, A. M. RAWN, H. A. FABER; H. J. CONWAY, Make-Up Editor; D. G. LEDGERWOOD, Advertising Editor.

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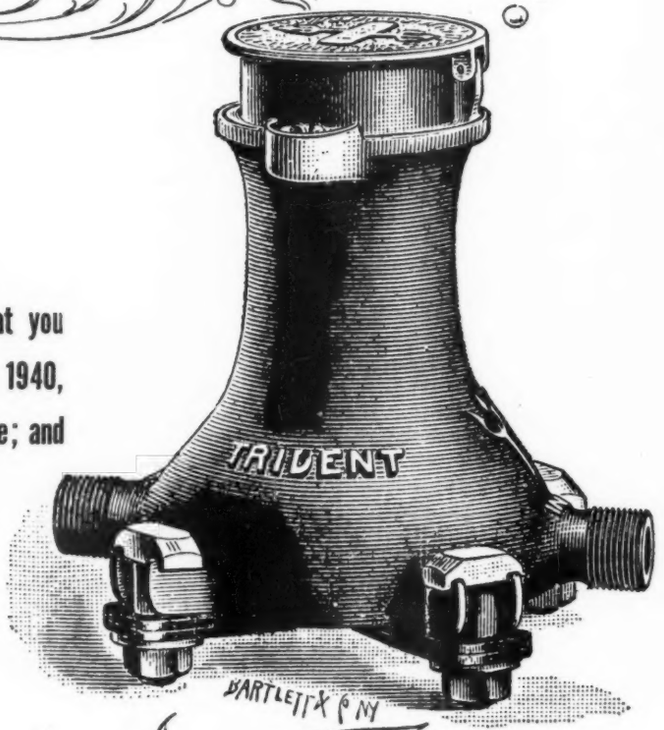

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WATER WORKS & SEWERAGE

VOL. 87, NO. 5 *A Gillette Publication* MAY, 1940

MILWAUKEE'S WATER PURIFICATION PLANT

By JOSEPH P. SCHWADA
City Engineer
MILWAUKEE, WISCONSIN

Part 2

The Filter Building and Appurtenances

THE Filter Building is 390 feet long and 297 feet wide, with the filter boxes and superstructure directly over a filtered water reservoir. There are thirty-two filters constructed in four rows of eight each along either side of two parallel pipe galleries and operating aisles (Fig. 12). A transverse or center gallery and a main aisle divide the rows so that the filters are arranged in groups of four (Fig. 1). The width of each operating aisle is identical to the width of the pipe gallery below. The top slab of the settled water conduit extended across the gallery forms the operating floor between the filters. The ceiling of the center gallery forms the floor of the main aisle above.

The Author

The interior of a filter unit showing the concrete wash water gullet, concrete wash troughs, surface wash piping, and the filter sand is shown in Fig. 13. The wash water outlet sluice gate is located at the rear of the filter bed. The bottom slab of the filter boxes forms the roof of the filtered water reservoir below. The under-drain system consists of perforated cast iron pipes running parallel to the wash troughs in each half of the filter box. These laterals connect into the filtered water duct which runs beneath the wash gullet, dividing each filter down the center.

The filtering medium consists of 24 inches of specially selected gravel and 27 inches of sand. The gravel grades in size from a 2½-inch maximum diameter at the bottom to a minimum of ⅛-inch at the top of the gravel layer, with a specific gravity of 2.50. On top of the gravel is placed a 5-inch layer of torpedo sand of size passing a No. 6 and retained upon No. 20 Standard sieves. The filter sand, 22 inches in depth, has an effective size of 0.55 and a uniformity coefficient of 1.2 with the effective size determined after particles passing a No. 42 sieve were removed. After the sand was placed in the filters it was backwashed continuously for an hour and all particles passing a No. 42 Standard sieve were removed.

Surface Wash System

The surface wash system (Baylis type) consists of a 16-inch line, with a 16-inch hydraulically operated valve, from the 36-inch wash water header into the filter bed, a 10-inch U-shaped header around the inside of the filter box and 64 1¼-inch laterals laid across the filter bed. (Fig. 13.) The center line of the 1¼-inch laterals is 2 inches above the surface of the sand. These are spaced 1 foot 9⅜ inches center to center and are drilled ⅛ inch

Part 1 of Mr. Schwada's article appeared in our April issue. In the first installment Milwaukee's new plant was described from the intake well step-by-step following the water flow up to the filters. From this point Part 2 takes the reader through the balance of the plant.

We regret to find that a typographical error slipped into the last sentence on the first page of Mr. Schwada's article. Even though the error is self-evident, we wish to re-state that the author's constant fight has now brought to Milwaukee the last word in filter-plants. Unhappily the word *"now" became "not" during re-setting of some of the type.—Ed.*

on 8-inch centers. The control for the system is located at the operating table.

The excellent lighting over the filter beds previously described is shown in Fig. 14. Note how the light reaches down to the sand surface of an idle unit.

When filtering, water normally stands within 1.5 feet of the top of the walks around the filter boxes, making 4.25 feet of water depth on the surface of the sand bed. At normal rates of back-wash, the surface of the sand rises above the surface wash laterals, thus making the jets from the latter effective in scouring the sand by the horizontal jetting.

Filter Equippage

The filter connections are made with steel fittings and cast iron flanged valves and sluice gates of the following sizes:

(Each filter of 6¼ mgd. capacity at 2 gal./sq. ft./min.)

Influent	30″
Effluent	20″
Backwash	36″
Surface wash	16″
Wash water outlet—sluice gate	66″×48″
Re-wash	8″

All filter valves are of the cast iron, bronze mounted, double disc type and the sluice gates are of the cast iron, bronze mounted seating type. The valves and sluice gates are actuated by bronze-lined hydraulic cylinders. The hydraulic piping from the cylinders to the control valves is of seamless copper tubing. The control for each filter is located in a tile-faced operating table in the operating aisle.

Each filter is equipped with a rate controller, set with the center line of flow vertically down, provided with a fluid counter weight so that it can be filled or emptied. Rate of flow is adjusted at the operating table by suitable buttons which in turn control the quantity of fluid in the counter weight.

A combined rate of flow and loss of head gauge is attached to each rate controller. The gauge which indicates and records on a thirty-day strip chart is actuated through linkage of pots placed in the operating table. Pressures are transmitted to the pots through the use of air pressure and piezometer tubes.

The following is a factual summary concerning the filters:

Number of filters	32
Sand beds in each filter	2

Fig. 12—Operating Aisle of Milwaukee's Filter Plant

(Note the glass block windows and artificial lighting.) The walls are of shaded green terra-cotta tile, the floors of reddish brown tiles.

Filtration Rates (mg/acre/day)	min. 126
	max. 189
Capacity, each unit (MGD.)	min. 625
	max. 9.37
General Dimensions:	
Each sand bed (64 units 19'x57') (sq. ft.)	1083
Depth of filter box (feet)	10
Width of trough inside (feet)	1.83
Clear distance between troughs (feet)	4.8
Distance between center lines of troughs (feet)	7.125
Filter Sand:	
Thickness of layer (inches)	22
Effective size (millimeters)	0.55
Uniformity coefficient	1.2
Filter Torpedo Sand:	
Thickness of layer (inches)	5
Size (inches)	0.033
Filter Gravel:	
First layer (1½"–2½" size)—(inches)	5
Second layer (¾"–1½" size)—(inches)	6
Third layer (½"–¾" size)—(inches)	5
Fourth layer (¼"–½" size)—(inches)	4
Fifth layer (⅛"–¼" size)—(inches)	4
Surface of sand to crest of wash-troughs (inches)	27
Bottom of filter to water surface (feet)	8.5
Under-drains:	
Lateral—diameter (inches)	4
Spacing (c. to c.)—(inches)	9
Orifices—diameter (inches)	7/16
Spacing (c. to c.)—(inches)	6
Area of each (sq. in.)	0.1503
Number	2809
Total area (sq. in.)	422.2
Radio, orifice area to sand area (x 100)	0.226
Rate of washing in vertical rise per minute (inches)	24–36
Location of wash gullet and filter inlet	Center
Location of waste drain	Back
Surface Wash:	
Connection—diameter (inches)	16
Headers—diameter (inches)	10
Laterals—nominal diameter (inches)	1.25
Inside diameter (actual)—(inches)	1.38
Spacing (c. to c)—(inches)	21.375
Orifices—drilling diameter (inches)	0.125
Spacing (c. to c.)—(inches)	8
Area of each (sq. in.)	0.0123
Number	1758
Total area (sq. in.)	21.623
Center line of lateral above sand (inches)	0.17
Wash Water:	
Tank—water capacity (net)—gallons)	760,000
Bottom above sand surface (feet)	53
Operating head (feet)	8–20

In designing the pipe galleries it was decided to provide more space than provided in most plants in order to facilitate both the installation of the equipment and its removal for repairs. It was also recognized that a liberal amount of space would tend toward easier and better maintenance of the equipment and the concrete structures. Therefore, the width of the galleries was made 22 feet.

A typical view of one of the pipe galleries with location of conduits, headers, valves, rate controllers, etc., is Fig. 15.

Wash Water System

The wash water system consists of two centrifugal pumps with capacities of 20 M.G.D. each, installed in the Pump Room, (Fig. 3) and a concrete tank underground on top of the bluff in the park. This tank is 100 feet square and is 10 feet deep. Its net capacity of 750,000 gallons is sufficient for at least two single filter washes without pumps in service. The vertical distance from the top of the sand in the Filter Build-

Fig. 13

Filter Bed. (A) Wash Water Gullet; (B) Sluice Gate; (C) Concrete Wash Troughs; (D) Sand Bed; (E) Surface Wash Header with (F) Laterals.

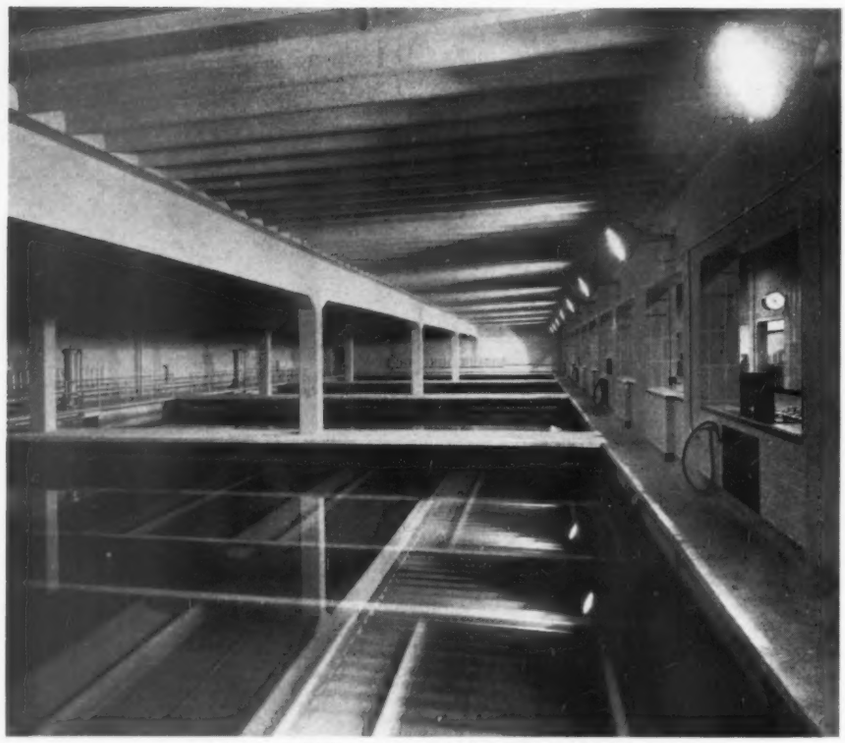


Fig. 14—Filter Beds Under Flood Lights
Note access doors to rear of operating tables, and hose lines for cleaning filter boxes.

ing to the bottom of the tank is 53 feet. A 60-inch steel pipe line extends from the tank underground into the south gallery of the Filter Building, where it connects with the 36-inch steel wash water headers in the east and west pipe galleries.

The wash water is taken from the effluent conduit in the sub-basement of the Chemical House through a 36-inch diameter steel pipe which extends to the suction end of both pumps. Each pump discharges the water through a check valve into a 24-inch steel pipe. Both of these pipe lines extend into the basement of the Chemical House where they are cross-connected. From this point a 36-inch steel pipe line extends southwesterly through the wall of the basement and connects with the 60-inch steel discharge line from the wash water tank. The pumps are operated manually, started when the water level in the tank reaches a predetermined level, and stopped when the tank is full.

The 36-inch wash water headers in the pipe galleries, in addition to being connected to the 60-inch wash water header in the south gallery, are cross-connected in the north gallery by a 60-inch steel pipe. This size is used so that, when the plant is expanded, another 60-inch wash water header from a second wash tank will readily fit in with the present layout in the north gallery. The 60-inch lines in the north and south galleries and the 36-inch headers in the east and west galleries thus form a loop in the galleries.

There are five 36-inch diameter valves in the wash water headers located so that it is possible to cut out of service any one-quarter, one-half, or three-quarters of the filter beds. This will facilitate maintenance and repair of equipment.

Plant Water Supply

The plant water supply is obtained from the Water Works distribution system through an 8-inch main which connects to a house service header in the basement of the Chemical Building. Provisions are being made for a second main to increase the reliability of the service. The hydraulic pressure system, chemical solution water system, plumbing, and fire lines are all supplied from the house service header.

The hydraulic pressure system includes two inter-connected pressure tanks, one in the center gallery and one under the wash water platform in the Pump Building previously mentioned, two booster pumps, and pressure reducing valves. The pressure in this system is automatically maintained at 100 pounds per square inch by the use of the reducing valves and the booster pumps. The pressure piping is arranged so that the booster pumps suction supply can also be taken from the wash water headers and the discharge connected to the house service header for limited emergency use.

Metering

A fairly complete system of metering has been installed to facilitate and improve the operation of the plant. This includes a set of recording instruments in the meter room of the Chemical Building and several indicating units in the pump and chemical feed rooms and in the Filter Building.

The recording instruments in the meter room are as follows:

1. North Raw Water Flow
2. South Raw Water Flow
3. Raw Water Discharge Pressure
4. Wash Water Flow
5. Wash Water Discharge Pressure
6. Wash Water Elevation
7. N. Coagulation Basin Elevation
8. S. Coagulation Basin Elevation
9. Clear Well Water Elevation
10. Raw Water Elevation in Shaft
11. Lake Michgian Water Elevation
12. Raw Water Temperature
13. Filtered Water Temperature
14. Settled Water pH Valve

All recording meters are 30-day strip type mounted semi-flush in a steel meter panel in the meter room. (Fig. 16.) Indicating meters pertinent to the particular operation are placed in locations convenient to the operator. In the pump room, nine 10-inch diameter meter indicating instruments for items 1, 2, 3, 4, 5, 6, 7, 8, and 10, mentioned above, are mounted on a panel near the switchboard. In the dry chemical feed room, 24-inch diameter double-faced indicators for items 1 and 2 are suspended in the aisle. (Fig. 7.) In the Filter Building, 24-inch diameter double-faced indicators for items 1, 2, 4, 6, 8, and 9 are bracketed at advantageous locations in the aisles. (Fig. 12.)

Transmitting devices are of the style and size deemed best suited for the particular installation. Flow is measured by welded steel venturi tubes equipped with bronze throats; pressures and elevations by liquid level devices; temperatures by resistance type thermometer bulbs; and pH by antimony-calomel electrode assembly. The size of

the Venturi meter on each of the raw water conduits is 84 inches by 54 inches, and on the wash water line 60 inches by 30 inches.

Laboratories

The laboratories on the second floor, adjacent to the dry chemical feed room, include two chemical laboratories for general analytical and research work; a bacteriological laboratory supplemented by a media preparation room; and a fuel testing laboratory for the analysis of coal, oil, etc., used in the water works. An office for the chief chemist is also included.

Considerable special equipment for properly controlling the treatment in the plant is provided in addition to the regular apparatus and chemicals required for the operation of the general laboratory. In the chemical laboratory this includes a stirrer for jar tests, two different kinds of turbidimeters, capable of measuring turbidities to 0.02 parts per million, complete equipment for quantitatively determining odor intensities by the "threshold number" method, a special colorimeter using a fluorescent lamp, and a pH meter equipped with a glass electrode for measuring the hydrogen-ion concentration. The laboratory pH meter is supplemented by a recording potentiometer (nearest instrument in Fig. 16) in the plant. It is connected to one of the settled water conduits to provide a continuous record of pH readings prior to filtration.

The bacteriological and media preparation laboratories contain equipment for making regular bacterial and microscopical examinations. The 37°C. incubator is the "walk-in" type, equipped with a heater and fan to maintain a uniform temperature throughout and contains specially designed stainless steel shelving for storing the cultures. The 20°C. incubator is also electrically controlled and is similar in appearance to a household refrigerator. A Sedgwick-Rafter apparatus with accessories has been provided for quantitative microscopical determinations.

In this laboratory, four sampling taps are provided for obtaining samples of raw water from the short shaft, filtered water from both the east and west effluent channels before post-treatment, and filtered water after post-treatment from the effluent short shaft.

All laboratory furniture is of wood construction and finished in an attractive silver green color. The table tops and laboratory sinks are made of acid resistant materials.

Heating

During the normal heating season, the Water Purification Plant is supplied with steam for heating purposes from North Point Pumping Station, approximately a mile and a quarter away. Steam from North Point steam header at 150 pounds gauge and 100°F. super-heat is metered, reduced to 60 pounds gauge and transmitted to the Water Purification Plant through an underground steam main.

The main is a 5-inch nominal diameter welded steel pipe with suitable anchors, expansion joints, alignment guides, traps, etc. It is insulated with an 85% magnesia sectional insulation of double standard thickness, covered with two layers of 55 pounds per 100 square feet asphalt saturated rag felt roofing. The main is laid approximately 3 feet underground in a concrete box conduit, 1 foot square inside.

At the Water Purification Plant, the steam pressure is further reduced to 5 pounds gauge through two reducing stations arranged in series. The steam then enters a header from which each building main takes its supply.

Boiler room equipment at the Water Purification Plant, connected to the steam header, consists of a hot water storage heater and a steam generating unit. The heater is of the closed type rated at 3,000 gallons per hour. The steam generating unit consists of an integral type of oil-fire, low pressure boiler capable of generating 3,000 pounds of steam per hour. The boiler is used only during the off heating season for heating hot water and other minor purposes. The steam generating unit also serves as standby for emergency heating requirement during the heating season.

Various types of heating units or radiation, each deemed best for the particular case, are used throughout the building. Floor type unit heaters are used in the pump room, concealed copper radiation in the filter building, unit heaters in the pipe galleries, and an indirect warm air heating system in the laboratories.

Architectural and Structural Features

The buildings are designed in the medieval style

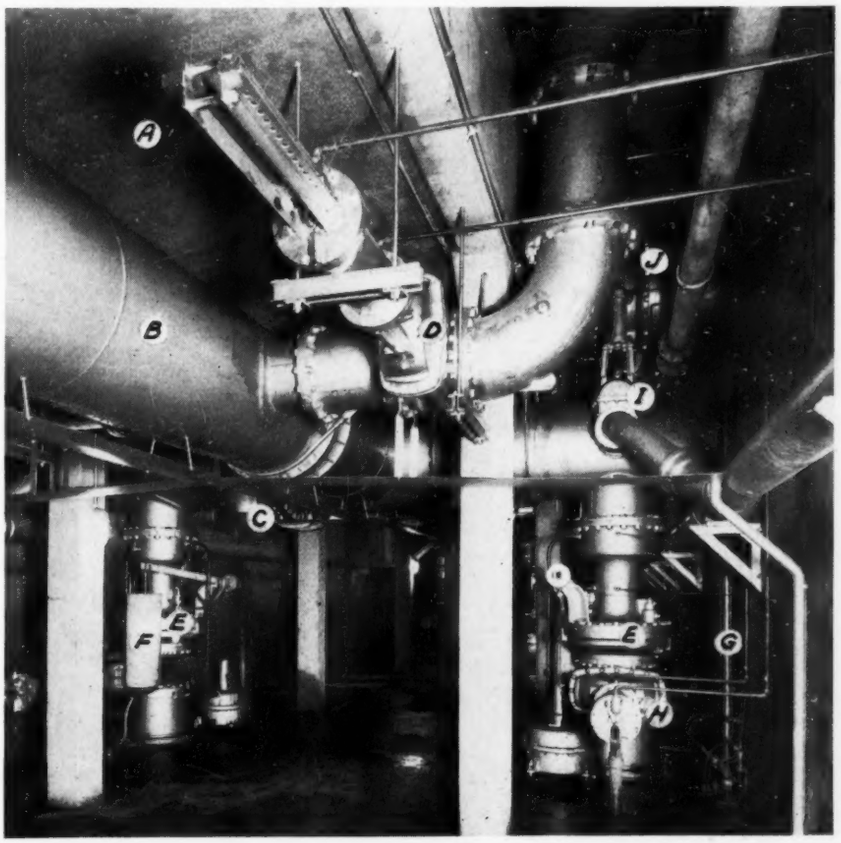


Fig. 15
Pipe Gallery. (A) Settled Water Conduit; (B) 36" Steel Wash Water Header; (C) 36" Wash Water Valve; (D) 16" Surface Wash Water Valve; (E) Rate-of-Flow Controllers with (F) Fluid Counterweight; (G) Piezometer Pipes; (H) 20" Effluent Valves; (I) 8" Rewash Valve; (J) 30" Influent Valve.

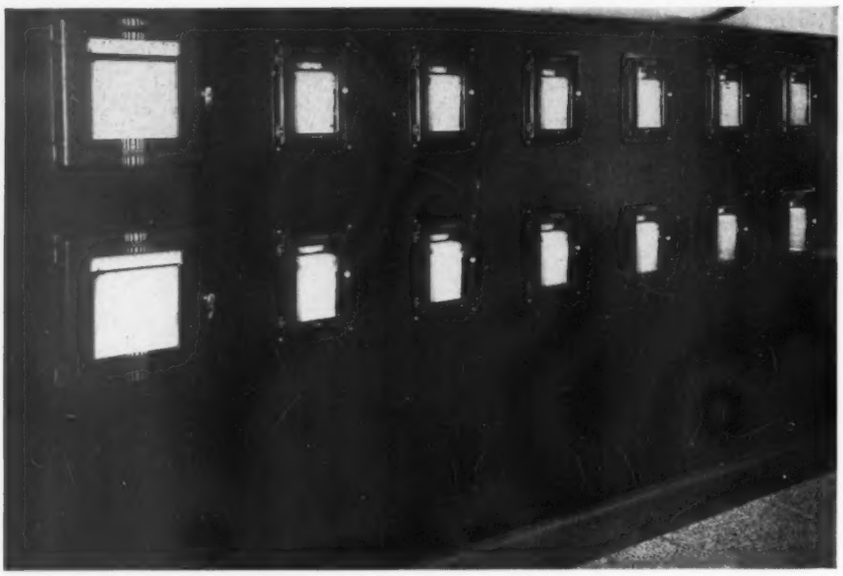


Fig. 16—30-Day Recording Instruments on Meter Panel

modified to fit modern conditions and the special requirements of a Water Purification Plant, with a marked vertical expression to contrast with the horizon line of Lake Michigan. Material for the exterior is a hard limestone, quarried in the neighborhood of Milwaukee, and the roofs, where not flat, are covered with variegated red Spanish tile.

Except where noted below, practically all walls are lined with glazed tile. The windows are either of wrought iron or aluminum and the doors of hollow metal. In the Filter Building glass block windows are used. All flat roofs are of concrete, covered with an insulation and composition roofing.

The Chemical Building has a structural steel skeleton because of the heavy loads superimposed by the steel storage bunkers and other chemical storage. Steel columns and floor beams below the second floor are encased in concrete. All floors throughout the building are built of concrete with rubber tile finish in the administrative offices and chemical laboratories. The walls of the Main Lobby are lined with Mankato stone and the floor is green marble and green slate in 12-inch squares, laid checker pattern.

The walls of the Pump Room are lined with terra cotta in two shades of tan, and the floor is red quarry tile. The steel roof trusses and crane runways are supported on steel columns embedded in the masonry walls.

In the Service Building, the steel roof trusses are supported on masonry walls, and the floors are concrete throughout. A solid wall separates the garage from the balance of the building.

The walls of the Filter Building Operating Aisles are lined with terra cotta in shades of light green. The floor is tile of a variegated reddish-brown color. Walkways around filter beds are built of concrete.

No piling was required to support any of the structures. Instead, after the site was dewatered, the bottom of the lake near shore was excavated to the required depth. Over the east half of the site, where the lake bottom was below the footings, sand was placed to support the structures.

Landscaping

With Lake Michigan on three sides, the buildings are set in a broad landscape of lawns and planting. The coagulation basins and reservoirs to the north and south of the buildings are covered with earth, forming terraces which offer welcome relief as they rise above the general level. The wide expanse of beautiful lawns above these underground structures, where the soil is too shallow to permit anchorage of plants in the prevailing high winds, adds materially to the attractiveness of the site.

The bulk of the planting, with the exception of the "foundation planting," is on the slopes which were made flatter for that reason. There are a few groups of trees and evergreens, but most of the shrubbery is in broad masses to conform to the prevailing horizontal lines and to establish the proper proportions between the size of the buildings and the expansive areas of lawn and water. This type of planting is used also because it provides self-protection against the severe winds which sweep the site.

An underground sprinkling system is installed over the entire site.

Remote Unloading Station

The nearest railroad siding is located approximately two and three-quarter miles from the Water Purification Plant. Along this siding, the city leased a tract of land 99 feet by 120 feet and constructed an Unloading Station of structural steel enclosed with galvanized corrugated sheet iron. This station contains two steel storage bins and equipment for pneumatically unloading bulk chemicals from box cars. Chemicals are temporarily stored in the two steel bins to reduce demurrage on the railroad cars and then are transported to the plant in a specially constructed, completely enclosed tank mounted on a dump truck.

Adjacent to the Unloading Station, a structurally supported monorail and electric hoist is installed to unload and store the ton cylinders of chlorine. A standard industrial type woven wire fence completely surrounds this property.

Cost of Plant

The cost of the plant, exclusive of interest during construction and financing expense, is approximately $5,100,000. The construction was financed by a $3,675,000 issue of revenue bonds, a Government grant of $1,285,690, and $139,310 of Water Department funds.

Personnel

The Water Purification Plant was designed and its construction supervised by a special staff of engineers and architects in the office of the City Engineer, with the firm of Alvord, Burdick and Howson of Chicago as consultants. Mr. Herbert H. Brown was in general charge of the design and construction; Mr. Walter Judell was responsible for the architectural work; Mr. Arthur Rynders for the mechanical work; Mr. Marshall Findley for the structural design; Mr. Herbert Schmitt for the construction; and Mr. Virgill Hurless accounting.

THE CONSTRUCTION OF SEWAGE TREATMENT WORKS

Its Relation to the National Economy*

The Author

By ABEL WOLMAN (Sc.D.)**
THE JOHNS HOPKINS UNIVERSITY
BALTIMORE, MARYLAND

IN THESE days of uncertainty all of us are naturally interested in the prospect for the future. It would be unnatural, therefore, if as citizens of the United States we were not concerned with general economic problems, and even more unnatural if we did not show similar concern regarding that sector of our economy with which we are professionally concerned.

During the past 10 years the United States has passed through so varied and complicated a series of basic changes that any conclusions which may have been apparent in 1939 may be viewed with less assurance in 1940.

If one reviews, however, the economic history of the United States from 1840 to 1940, only a century in the history of time, one begins to discern even in our complex economic experience some important indications of the future.

The Past and the Present

What has been the construction experience since the World War Period? In describing or analyzing that experience a variety of other collateral issues assume great importance in determining an answer to our primary question. Some of the collateral situations are worth recording as the setting within which the problem must be discussed. From 1929 to 1939 the per capita gross debt of the Federal Government has risen from $139 to $305. The national debt declined from a World War high of approximately $25,500,000,000 in 1919 to a low in 1930 of approximately $16,000,000,000. In 1940 it had risen to somewhat less than $45,000,000,000.

Of equal significance in the setting for our discussion of future capacity for productive work is the consideration that the United States, with only approximately 7 percent of the world's population, possesses over 40 percent of the combined resources of the world.

Since the expenditures, past, present and future, in which we are interested rest heavily upon federal, state and local tax revenues, it is of importance to recall that in 1930 the total federal, state and local tax collections amounted to $14,811,000,000. This figure represented $114.09 per capita and amounted to 21.8 percent of the average of the estimated income for the calendar years 1937 and 1938.

The most important single source of tax revenue in the United States is the property tax. In 1938 this tax produced approximately $4,750,000,000, not including special assessments. Of the $114.09 per capita tax revenue, the Federal Government accounted for $46.48, the state $29.71 and local government $37.90.

These revenues flowed backwards and forwards through federal, state and local distributing centers for the various forms of public activity. How much of these flows of funds found their way into the general construction industry and how much into the specific form of sewage treatment works?

In 1915 the total new public construction activity in the United States was only $715,000,000. It reached a peak in 1930 of $2,770,000,000. In 1939 public construction reached a probable figure of $2,800,000,000. A summary of these changes in both private and public construction is shown in table 1.

The total value of construction work done during 1939 is estimated to have amounted to slightly less than $10,000,000,000. The total for 1939 was more than two and one-half times as large as the low value reached in 1935.

Despite this increase, total expenditures on construction in 1939 were less than three-quarters of those attained in the peak years of 1926 to 1929, although the physical volume of construction last year was probably as much as seven-eighths of that reached at the peak, if adjustment is made for changes in construction costs.

Within the decade 1930-1940 expenditures for sewers

TABLE 1

Estimated Value of Total Private and Public Construction[1]

(Millions of dollars)

Item	1926 to 1929 Aver.	1932	1933	1936	1937	1938	1939[2]
New Construction:							
Private	8,363	1,767	1,091	2,531	5,326	[3]2,932	3,515
Public	2,339	1,794	1,216	2,154	2,014	2,157	2,800
Total	10,702	3,561	2,307	4,705	5,340	5,089	6,315
Work relief construction[4]			114	1,130	775	1,202	1,032
Maintenance:							
Private	2,195	1,128	1,016	1,742	1,854	1,837	1,800
Public	765	624	527	710	718	736	800
Total	2,960	1.752	1,543	2,452	2,572	2,573	2,600
Total construction:							
Private	10.558	2,895	2,107	4,293	5,120	4.762	5,315
Public	3,104	2,418	1,857	5,994	3,507	4,095	4,632
Total	13,663	5,313	5,964	8,287	8,687	[3]8,864	9,947

[1] These estimates measure construction activity as represented by actual expenditures for labor, material, and other items. Figures beginning with 1915, substantially comparable with those presented above, are shown in Domestic Commerce Series No. 99, Construction Activity in the United States, 1915-1937, by Lowell J. Chawner, and in Recent Developments in Construction Activity by Samuel J. Dennis, Survey of Current Business, August, 1939, both published by the Bureau of Foreign and Domestic Commerce.

[2] The estimates for 1939 are based on incomplete data and are subject to revision.

[3] Revised.

[4] Work relief not elsewhere included.

(Page 17, February, 1940, Survey Current Business, United States Department of Commerce.)

* An address delivered at the Silver Anniversary Convention of the New Jersey Sewage Works Association at Trenton, N. J., Mar. 21, 1940.

** Head of the Department of Sanitary Engineering, and Consulting Engineer.

and sewage treatment works have varied from a low in 1933 of less than $56,000,000 to a high in 1937 of over $250,000,000. In 1939 the expenditures for this special purpose have again dropped to less than $150,000,000.

A comparison of the long time trends in construction and those in other industries is a difficult one to make except in very rough approximation. A number of investigators have attempted to estimate average annual rates of growth in various items of our economy. Some of these efforts are shown in table 2.

TABLE 2
Average Annual Rate of Growth, Selected Series
(Unit 1%)

Series, shown, period 1870-1930	Rate
Total population	1.9
Urban population	3.2
Building permits per capita Riggleman[1]	-0.1
Construction activity[2]	3.0
Manufacturers (Day-Persons)	4.3
Mining (Day-Persons)	5.7
Agricultural crops (Day-Persons)	2.3
Trade (Snyder)	4.7
Total production (Day-Persons)	3.7
Series shown, period 1885-1929	**Rate**
Construction and building materials:	
Rail consumption	1.0
Cement, total	8.6
Asphalt	8.0
Other durable products and related raw materials:	
Bituminous coal	4.3
Iron ore	4.4
Steel	7.2
Copper consumption	6.0

[1] These particular series are shown in Production Trends in the United States, but have been calculated from other data, using Dr. Burns' method of calculation.

[2] From 1870 to 1900, based upon trend in building permits (Riggleman) with all allowance for trend in urban population, weighted 3, and rail consumption, weights 1; from 1900 to 1930, based upon the trend in new construction.
(Construction Activity in the United States 1915-37, United States Department of Commerce, Bureau of Foreign and Domestic Commerce, Page 32.)

The findings in table 2, approximate as they are, indicate that the average annual physical volume of construction per capita, over long periods, has not changed appreciably during the past 60 years.

This situation is particularly striking on the Federal level where the rate of public works expenditures from 1810 to 1940 has followed very closely, until 1933, the rate of total federal expenditures, if we omit from the latter the extraordinary expenses of the War of 1812, the Civil War and the World War. The Federal public works expenditures curve almost parallels the curve of increase of national wealth from the period 1850 to 1930. After 1930 artificial adjustments, of the kind familiar to this group, have been responsible for maintaining the rate of Federal public works expenditures, while the curve of national wealth has departed from it.

It may be concluded, therefore, from this very hasty review of the past and the present that construction work in general has followed a consistently upward increase in volume and that sewage works construction has taken a consistently important portion of the construction funds throughout our history. What of the future?

The Necessities of the Future

In 1930, just prior to the major collapse of our economy, Leo Wolman,* in discussing public works construction, stated: "While it is impossible to make a statistical estimate of the probable expenditures on public works in the next years, it is clear that the principal spending agencies are behind in their programs of permanent improvements." He called attention also to the pressing physical requirements still unmet and to those necessities which rising standards of living would create in this country. [* Economist: brother of the author.—Ed.]

This prediction was followed by one of the cyclical disturbances to which reference has already been made, so that during the subsequent three years public construction was cut almost in half and the construction of sewers and sewage works was correspondingly reduced. This lag in fulfilling the requirements of a growing population has not been met by the stimulation which was given to public works construction by the Federal financial program, particularly since the peak of public construction in 1939 has not reached a figure equal to that of 10 years ago.

It is almost impossible to measure the future requirements for public works and maintenance, because of the many imponderable limitations involved. There is little doubt, however, in the light of the accumulated repair work, the great amount of urban street reconstruction which would be undertaken, and the requirements which arise from the growth and shifting of populations, that the construction needs of the next five years are of a magnitude at least equal to the actual construction of the late 20's.

When we speak of imponderables, attention is necessarily called to a slowing down of general population growth. When this tendency is applied to specific instances in the construction industry, the general effect is by no means downward. For example, although the enrollment in grade schools in the United States has declined by one million from 1929 to 1935, the high school enrollments are still increasing, having risen from 1929 to 1935 by over two and one-half millions.

Requirements in the highway field, and increased residential building to meet a backlog of tremendous delay in construction, represent additional imponderables which should raise the curve of construction.

When we turn, however, to the field of sewers and sewage treatment a more satisfactory picture for the future may be quantitatively evaluated. It is reasonably clear that the next 10 years should encompass a sewage treatment program for municipalities alone of approximately $1,000,000,000. This figure does not include important installations of lateral and intercepting sewers. It gives no great weight to the unsewered populations which run into thousands in our major cities and metropolitan areas. For example, in Baltimore City, which is currently credited with having complete sewerage treatment facilities, a construction program of no less than $10,000,000 is essential for the not too distant future to provide facilities for populations not yet served and to extend sewage treatment for streams which are still highly polluted.

The same can be said for New York, Los Angeles, San Francisco, Washington, Philadelphia and Detroit. When we add to these requirements the almost complete absence of any treatment facilities for Boston, Pittsburgh, Cincinnati, Portland, Kansas City, St. Louis, Louisville, Philadelphia and others, it becomes apparent that much remains to be done.

In the industrial waste treatment field it is probable that over $1,000,000,000 will be necessary for construction purposes within the next 10 to 15 years. This is upon the highly improbable assumption that no particular growth beyond present anticipations will occur in the industrial field. The future will no doubt disclose that these possibilities are underestimated.

These figures, representing approximately $200,000,000 of annual expenditures for construction of sewage treatment works alone for the next 10 years, are believed to be conservative, since they make no provision for the repairs increasingly necessary in the older plants of the United States or for the abandonment of works

which have proven to be obsolete, either because of process or equipment.

The figures likewise do not take into account the development of new areas of concentration of population which have always arisen in the history of our country. It is unlikely that they will not occur in the future. One of the most important of these, for example, is in the Pacific Northwest where there is little doubt that resettlements of population from 500,000 to 1,000,000,000 are likely to occur during the next two or three decades.

In addition to these necessities expenditures undoubtedly will be required to meet increasing standards for extended recreational areas, the requirements for improved physical appearance and the demands for adequate protection of fish and other biological life will add to the construction requirements of the next 20 years. Further research in the fields of pathogenic organisms may give added pressure for the correction of waste disabilities in receiving bodies of water. It should be remembered that only half of the present population now served by sewage treatment facilities is provided with secondary treatment.

Research findings may also disclose added justifications for the treatment of sewage because it may be a carrier of some of the virus diseases. Already the finger of suspicion has been raised toward sewage discharge in connection with the spread of infantile paralysis. Whether this suspicion is confirmed or not, it and other aspects of sewage pollution control may raise the conservative figures already presented.

Fiscal and Administrative Problems

Any review of the past performance and the future possibilities in this field of public works construction would be incomplete without some reference to the important limitations which fiscal policy and practice place upon construction activity. With rising tax rates, with mounting federal, state and local bond indebtedness, with increasing antagonism to public expenditures by the public, one cannot help but be aware of the sigificance which fiscal policy and practice will have in the future construction program.

For those of us interested in the construction field in general and in sewage works in particular it cannot be too strongly emphasized that construction for the most part tends to be large, when the total production and levels of real income are adequate not only to meet expenditures for consumable necessities, but also to provide for outlays for shelter, utilities and other works and structures which contribute to general well-being. A second factor which tends to increase construction is an efficient organization of both public and private agencies for the extension of credit at moderate rates of interest and with soundly conceived methods for the periodic retirement of loan obligations.

These and other considerations, equally important with respect to the current trends of general economic activity, are all aspects with which such associations as the New Jersey Association should concern themselves.

The writer takes the liberty of indicating some of the fields in which safeguarding of the construction activity for the future may be accomplished through the efforts of local and national professional groups.

The future, for example, will require a more satisfactory advance programming for public works than has been generally provided in the past. It is surprising to note how few American cities prepare their public works budgets for much more than one or two years in advance. The habit of long term schedules is one which should be emphasized, particularly where it implies as it does in this case a procedure demanding annual review and revision so as to meet changing conditions or emergencies. Expenditures for sewage works in the future would attain and maintain a more satisfactory level if such advance programs were seriously adopted and followed by the major portion of the cities of the United States.

The mere listing and inventorying of the public improvements needed or desired in a community, provided it is based upon sound engineering review, is a first essential step to stabilize activities. A concomitant analysis of the city's financial resources, commitments and expenses should supplement the engineering construction program. With those available for careful review, a useful and practicable long-term schedule of construction should be prepared for every community. It should then pass naturally into the channels of legislative approval and public acceptance.

Less than a dozen cities in the United States have so far developed an orderly process for long range budgeting in the public works construction field. The sewage works designer and constructor is certainly in a position to correct this defect and in so doing can facilitate necessary construction expenditure.

Similar reflections may appropriately be made with respect to the general accounting principles and practices which are used or rather which are not used in most American cities. Here, too, progress is being made in some cities on standardizing accounting practices so that their application to this field may be improved and extended. Stocktaking on a uniform basis in the field of sewage works construction and maintenance is important for the future.

Every state should give consideration likewise to reasonable limitations to be established by statute for a minimum term for public works bond issues. Abuses in the past, where the term of bonds for short-life structure has exceeded in some instances 85 to 90 years, are responsible in no small degree for some of the financial disabilities with which local governments are now too frequently confronted. Very few states or their local subdivisions have provided for limitations of bond issue terms. The practice in New York, New Jersey, Maryland, Massachusetts and Michigan, among others, should be carefully scrutinized so that their best values in this connection may be adjusted and adapted to the requirements of other areas. It should be remembered that the governing bodies of many subdivisions of government, because of their short term in office and their unfamiliarity with fiscal practices, are unable to adjust the financial requirements of their community to an intelligent and logical long term program. For these, and there are myriads of them, the state must provide guiding principles and limitations.

If these restrictions had been in force 40 to 50 years ago the field for public works construction of today would be wider and safer. Baltimore, for example, would not be paying interest charges in 1940 on a bond issue sold in 1865. The programming of interest and amortization charges on past and future issues of bonds represents a fertile field for intelligent handling of construction programs to come. These in turn should be balanced against the merits and demerits of pay-as-you-go programs. The pay-as-you-go plan, a depression product, has obvious advantages, but cannot be universally substituted for long term bond issues necessary for constructing works of permanent and long life.

Increasing search must likewise be made for more satisfactory methods of payment for the construction of sewage works. The recent inventory or survey of the

administrative practices and experiences of more than 100 cities, carried out by the American Public Works Association, discloses increasing use of the sewer rental plan for financing sewerage and sewage treatment systems. This change has been rapid in the last 10 years and likewise represents a depression result, since many of the cities have turned to sewer rental revenues when confronted with the impossibility of obtaining sufficient funds out of general property taxes.

The special authority scheme for avoiding general tax revenues has found new sponsors in our construction program. These too must be carefully evaluated so as to facilitate rather than to retard adequate construction and permanent fiscal safety.

Coupled with these complicated problems of finance are equally complicated problems of administrative structure. This point need not be emphasized except to point out that the problem of pollution abatement on such extensive river basins as the Delaware and the Ohio raises new challenges as well as opportunities in the field of administrative structure and machinery. Their administrative, fiscal and engineering solutions may retard or increase the rate of construction activity during the next 10 to 20 years, for the sewerage necessities of the cities and industries of these two river basins alone will cost in excess of $125,000,000.

Municipalities should likewise extend their horizon beyond their political boundaries in order to envisage the problems of metropolitan areas impinging upon their boundaries. The provincialism of the city must give way to thorough analysis of the entire metropolitan area, even though the problems of joint management and finance of comprehensive sewerage and treatment facilities may be and are complex. Sufficient precedent in organization and in fiscal practice is already at hand, however, for meeting the problems of overflow areas and multiple governmental units. Attention to them should not be postponed.

On a broader geographical scale, the problems of stream flow regulation for pollution abatement purposes must be integrated with the comprehensive hydrologic management, and fiscal issues of multiple uses of our streams. Here indeed is virgin territory for pioneer exploration!

Summary

There is no reason to suppose from the past history of construction that there will be any important abatement of construction in the next 10 to 20 years. Sufficient backlog in construction necessities, normal increases in population growth, reasonable demands for increased standards of living, more satisfactory budget programming and fiscal practices, should all lead to current improvements and extensions in general works construction. In the field of sewage works construction several billion dollars worth of potential work is in sight. It should represent something of the order of $200,000,000 or more per year for the next 10 years. It will rise above or fall below the figure depending upon the general economic status of the country. The fiscal policies of the various levels of government, the intelligence of public works officials in advance planning, the development and maintenance of standards of stream cleanliness and other measurable and controllable factors will modify this program in some degree. The total volume of necessities, however, will not decline. These necessities are easily discernible and the resources of the United States are sufficiently impressive and permanent enough to warrant looking forward to the future with reasonable equanimity and courage.

MAKING PIPE BUSHINGS FROM STANDARD PIPE

A Handy Kink

By W. F. SCHAPHORST, M.E.

NEWARK, N. J.

Do you know that first class pipe bushings can be made out of standard pipe? Many users of pipe don't know that it can be done. Or, if they know that it can be done they don't know the correct size of drill to use for tapping. I have occasionally made bushings out of pipe, but each time I found it necessary to first look into my handbook for the drill size to use and that is so much trouble that it is frequently easier to go to the store and buy a new bushing. Recently, though, I collected all of the data together for all bushings that can be made out of ordinary sizes of extra heavy and double extra heavy piping, compiled the figures in tabular form, and here they are.

For example, to bush from ¼" to ⅛" get a piece of ¼" extra heavy pipe sufficiently long for cutting the outside thread. Then cut the end off to the desired length, drill or ream with a 21/64" drill (diameter of drill 0.328") and then tap with a ⅛" pipe tap. That's all there is to it.

This accompanying table tells the complete story for all ordinary sizes: Note that in one case, ⅜" to ¼", the internal diameter of ⅜" extra heavy pipe is such that no drilling is necessary.

Note also that in bushing from ½" to ⅜" either extra heavy or double extra heavy piping can be used.

To Bush From	Use This Size Pipe	Use This Size Drill or Reamer
¼" to ⅛"	¼" X	21/64" drill = 0.328"
⅜" to ¼"	⅜" X	None.
½" to ⅛"	½" XX	21/64" drill = 0.328"
½" to ¼"	½" XX	27/64" drill = 0.422"
½" to ⅜"	½" XX	9/16" drill = 0.562"
½" to ⅜"	½" X	9/16" drill = 0.562"
¾" to ⅜"	¾" XX	9/16" drill = 0.562"
¾" to ½"	¾" XX	11/16" drill = 0.688"
1 " to ¾"	1 " XX	29/32" drill = 0.907"
1¼" to 1 "	1¼" XX	1/18" drill = 1.125"
1½" to 1 "	1½" XX	1/18" drill = 1.125"
1½" to 1¼"	1½" XX	1-15/32" drill = 1.468"
2 " to 1½"	2 " XX	1-23/32" drill = 1.72 "
2½" to 2 "	2½" XX	2- 3/16" drill = 2.187"
3 " to 2½"	3 " XX	2- 9/16" drill = 2.562"
3½" to 3 "	3½" XX	3- 3/16" drill = 3.187"
4 " to 3½"	4 " XX	3-11/16" drill = 3.688"
4½" to 4 "	4½" XX	4- 3/16" drill = 4.187"
	X = extra heavy pipe. XX = double extra heavy pipe.	

THE KANSAS CITY CONVENTION

Sets a New Mark in A.W.W.A.'s Onward March of Progress In 1941 It's Toronto

J. Arthur Jensen (Minneapolis) Retiring President

Award Winners.

W. Victor Weir (University City Mo.) Diven Medalist.

Thos. H. Wiggin (New York) The Goodell Prize.

Norman J. Howard (Toronto) Incoming President

THE rate of early registration for A.W.W.A.'s 60th Annual Convention in Kansas City, April 21-25th, presaged a highly successful meeting. By the second day a new attendance record had already been established in paid registrations. At the close of the convention an all-time high had been established—the official count being 1465.

It takes more than a record attendance, however, to make a record convention. And it seemed apparent at Kansas City that, from all angles, there has never been a more all-around successful convention of A.W.W.A. than that of 1940. It started off with the ear-marks of such, and the voice of those attending through to the end declared it such form the standpoint of technical program, entertainment, the weather, general arrangements, and manufacturers' exhibits.

In respect to the latter the number, the quality and attractiveness of the exhibits, made possible through the use of Kansas City's spacious and adaptable Municipal Auditorium, proved a source of satisfaction to all concerned. Other than the fact that the eye-pleasing array and the harmony of color is not reproduced, the accompanying pictures of the exhibit hall tell a story in themselves. Thus was ample proof at hand to confirm the wisdom of A.W.W.A.'s Directors in deciding two years ago to depart from the custom of holding meetings and exhibits only in hotels having such facilities, and going to the scheme of using auditoriums for the purpose, wherein greater facilities are at hand for holding more comfortable meetings and less cramped exhibits. At Kansas City there were 147 exhibit spaces occupied by close to 100 exhibitors (99 by count), and another convention record established.

Entertainment and Trips

The arrangements in respect to entertainment brought high praise to those responsible. Particularly loud in this praise were the ladies attending—a true test.

On Monday evening the high-light of the opening dance proved to be the exhibition of Western dancing of an earlier day by a troupe of folk-dancers from Colorado Springs, Colo.

On Tuesday evening there was the customary All-Division Dinner" followed by a worthy floor show and dancing. The "Red Gulch Jamboree" on Wednesday evening proved to be a facsimile of a wide open gambling town of the western gold-rush days, and plenty of "atmosphere" for the occasion. Conventioneers, staked to a stack of A.W.W.A. dollars, made their piles or lost at Black Jack, Roulette, Dice, Bingo, etc., until the biggest winners, at the sound of the gong, were awarded prizes in exchange for their winnings. Then on Thursday evening came the brilliant Annual Dinner and Dance, pictured with this account from high above in the spacious and colorful Auditorium Arena.

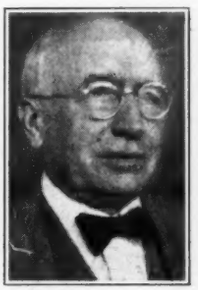
The ladies were royally entertained with sight-seeing, fashion show, luncheons and a bridge party at one country club, while the men golfers held their tournament on Thursday at another.

McNutt Featured Speaker

At the All Division Dinner, the Federal Security Administrator, Paul V. McNutt, was the guest speaker. The handsome and towering former Governor of Indiana, and once High Commissioner of the Philippines, was introduced by Col. Willard Chevalier who did a splendid job at it. A clever exchange of witticisms and repartee between our Colonel and Harry Jordan's former Governor served to break a lot of "political ice" before the latter got under way with a splendid address on "The Government and Water Supply" in which he traced the history and contributions of the U.S. Public Health Service toward

New Vice-President and Honorary Members.

Louis R. Howson (Chicago) Vice-President.



Jas. G. Gibson (Charleston, S. C.) Honorary Member.

John A. Kienle (New York) Honorary Member.

Geo. H. Fenkell (Detroit) Honorary Member.

improved and safe water supplies. Then in connection with the new Social Security Act, he pointed out that under Title 6 of this Act, engineers on the staffs of State Departments of Health had since 1936 been increased from 169 to 353 and appropriations for State Sanitary Engineering Divisions had been boosted by $1,000,000 under the Act. One activity supported under the Act is the Vocational Training Schools for Water Works Operators,—with such schools having been established in New York, Michigan, Oklahoma, Texas and Louisiana. Many trained water works operators are now holding full time instructorships in these schools.

In his closing remarks, the Security Administrator, under whom comes the U.S. Public Health Service, referred again to the Treasury Standards for Drinking Water (established 1914 and revised 1925) which he indicated would in turn give way within the next two years to new regulations of broader scope and significance which will embody a *Code of Water Works Practice.*

Hosts.
T. D. Samuel, Ch. Engr. & Supt.
Kansas City, Mo.
Geo. F. Gilkison, Sup't. Filtr.
Kansas City, Mo.
L. B. Mangun, Sup't. Filtr.
Kansas City, Mo.

Practice

(NOTE: As the Administrator of the Federal Security Act, Mr. McNutt had prepared a carefully studied and well developed address along the lines requested of him. His appearance before A.W.W.A. had no political significance whatever, the arrangements having been made long before his announced intentions to become a candidate for the presidential nomination. But for the repartee, brought on by allusions in Col. Chevalier's introduction, the audience heard nothing of a political vein in the Administrator's address.—Ed.)

Toronto 1941 Convention City

In his splendid acceptance speech at the close of the convention, President Norman J. Howard announced that the Board of Directors had honored the Canadian Section in selecting Toronto as the place for the 1941 Convention. This, he explained, was done, however, with the understanding that should war developments render the holding of a convention in Canada questionable, a change to some nearby city in the States would be made.

Honors and Awards

The feature of the Banquet on the closing night was the conferring of Honorary Memberships and presentation of awards and medals.

Honorary Membership was conferred on:
George H. Fenkell, Detroit

Jas. E. Gibson, Charleston, S. C.
John A. Kienle, New York City
Herbert M. Lofton, Chattanooga, Tenn.

To *Wm. V. Weir,* Engineer and Sup't. of the St. Louis County Water Co., University City, Mo., went the coveted Diven Medal — the highest award of A.W.W.A., presented annually to that member performing an outstanding service to the Association. The medalist was cited specifically for his work as Chairman of the Committee on Distribution Records and also for other valuable services to A.W.W.A. in past years. (The report of this Committee was printed in the Feb. 1940 issue of the Journal.)

Jointly to *Thos. H. Wiggin,* Consulting Engr., New York City, and *Melvin L. Enger,* Dean of Engineering, University of Illinois, went the Goodell Prize for their paper—"A Proposed New Method for Determining the Barrel Thickness of Cast Iron Pipe"—published in the May 1939 issue of the Journal.

Directors.

(1) *Herbert H. Brown of Milwaukee (Wis. Section);* (2) *Frank C. Amsbary, Jr. of Champaign, Ill. (Illinois Section);* (3) *Cecil K. Calvert of Indianapolis (Indiana Section);* (4) *Robt. C. Bardwell of Richmond, Va. (Virginia Section);* (5) *Felix Seligman of Duluth, Minn. (Minnesota Section);* (6) *Chester A. Truman of Colorado Sprs., Colo. (Rocky Mt'n. Section);* (7) *Wade Plummer of Butte, Mont. (Pacific N. W. Section).*

George W. Fuller Awards

To the following members went the George W. Fuller Awards voted by the several sections to members "for some notable or distinguished service in the water supply field." The section voting the award is bracketed.

R. F. Goudey* (California)
Theo. J. LaFreniere (Canadian)
Carl A. Hechmer (Four States)
Frank C. Jordan* (Indiana)
L. G. Lenhardt (Michigan)
Lincoln VanGilder (New Jersey)
Chas. R. Cox (New York)
H. G. Baity* (N. Carolina)
B. V. Howe (Rocky Mountain)
Paul Weir (Southeastern)
Leroy H. Scott (Southwest)
Marsden C. Smith (Virginia)
Perkins Boynton (West Virginia)
L. F. Warrick (Wisconsin)
A. V. Graff (Missouri Valley)

(All recipients except those with an * were on hand to receive the award and hear the citations read.)

Section Awards

The Hill Cup, to that Section showing the largest percentage in membership gain, was won by the Southwest Section, which recorded a member gain of better than 73%, and indicative of the results from a new member drive just prior to the 1939 meeting of the Section. The runner up was the North Carolina Section, which recorded a gain of 33.3%. (The West Va. Section won this cup in 1939.)

Karl M. Mann (New York) Pres.-Elect Water Wk's. Mfgr's. Assn.

J. Herman Smith (Boston) Chairman of Committee on Exhibits.

The Henshaw Cup, to that Section registering the highest number of actual plant operators in terms of percent of total registration for its annual Sectional Meeting, was won by the Wisconsin Section, reporting 89.8%, whereas close behind came West Virginia (88.54%) and North Carolina with 88.2%. (In 1939 North Carolina was the winner of this cup.)

The Old Oaken Bucket, which is the real thing from a New England farm well, remains in the possession of the California Section. The latter was successful in building its membership sufficiently to prevent the envious New York Section from capturing this once moss-covered trophy. This unique "cup" remains from year to year in the possession of that Section boasting the largest total membership, and for which the New York and California Sections wage annual battles.

Kansas City to Soften Water

(A.W.W.A. Approves)

Wednesday afternoon was devoted to a tour of inspection of the filtration plants and pumping stations of the two Kansas Citys—Missouri and Kansas. At the first, visitors saw an experimental softening plant in operation, indicative of the fact that before too long Kansas City, Mo., will enjoy a softened water rather than the hard water which many conventioneers found somewhat difficult to "get along with."

New Officers

The following Association and Section officers were elected or named by the Board of Directors:

President, N. J. Howard, Toronto
Vice-President, L. R. Howson, Chicago
Treasurer, W. W. Brush, New York
Secretary, H. E. Jordan, New York
Executive Committee—N. J. Howard, L. R. Howson, S. F. Newkirk, John A. Kienle, Linn H. Enslow

Wheel Horses.

John A. Strong (Kansas City) *E. L. Filby (Kansas City)*

(Their work on Entertainment and Promotion Committees meant much to the success of the Convention.)

Plant Management Division

Chairman—L. S. Vance, Chief Engr., Louisville, Ky.
Vice-Chairman—A. M. Brenneke, City Engr., Denison, Texas

Manufacturer's Exhibits.
Proved the Best in A.W.W.A.'s History.

(1) *Secretary Harry Jordan and Mrs. Harry, Port Washington, L. I.*; (2) *John W. Pray, Sup't. of Water, and Mrs. Pray, Fort Dodge, Ia.*; (3) *August V. Graf, Chief Chem. Engr., St. Louis Water Dep't., and Mrs. Graf*; (4) *H. S. Merz, Sup't. of Water, and Mrs. Merz, Rockford, Ill.*; (5) *Frank Kriz, Engr. of Distribution, St. Louis Water Dep't., and Mrs. Kriz*; (6) *"Clint" Inglee, President, Nat'l Water Main Cleaning Co., N. Y. City, and Mrs. "Clint." (As Chairman of the General Committee on Entertainment "Clint" was "happy about the whole thing.")*

Sec'y.-Treas.—Scotland G. Highland, Gen'l. Mgr., Clarksburg, W. Va.
Directors—W. L. McFaul (Hamilton, Ont.); J. S. Longwell (Oakland, Calif.)

Purification Division

Chairman—Paul Weir, Sup't. Filtr., Atlanta, Ga.
Vice-Chairman—M. M. Braidech, Professor, Cleveland, Ohio.
Secretary—Chas. R. Cox, San. Engr., Albany, N. Y.
Directors—M. C. Smith (Richmond, Va.); Chas. Spaulding (Springfield, Ill.); W. S. Mahlie (Fort Worth, Tex.)

Finance & Acc'tg. Division

Chairman—John C. Flannagan, Registrar, St. Paul, Minn.
Vice-Chairman—Geo. F. Hughes, Manager, Denver, Colo.
Sec'y.-Treas.—W. V. Weir, Sup't., University City, Mo.
Directors—M. F. Hoffman (Cincinnati); Dale F. Maffitt (Des Moines, Ia.)

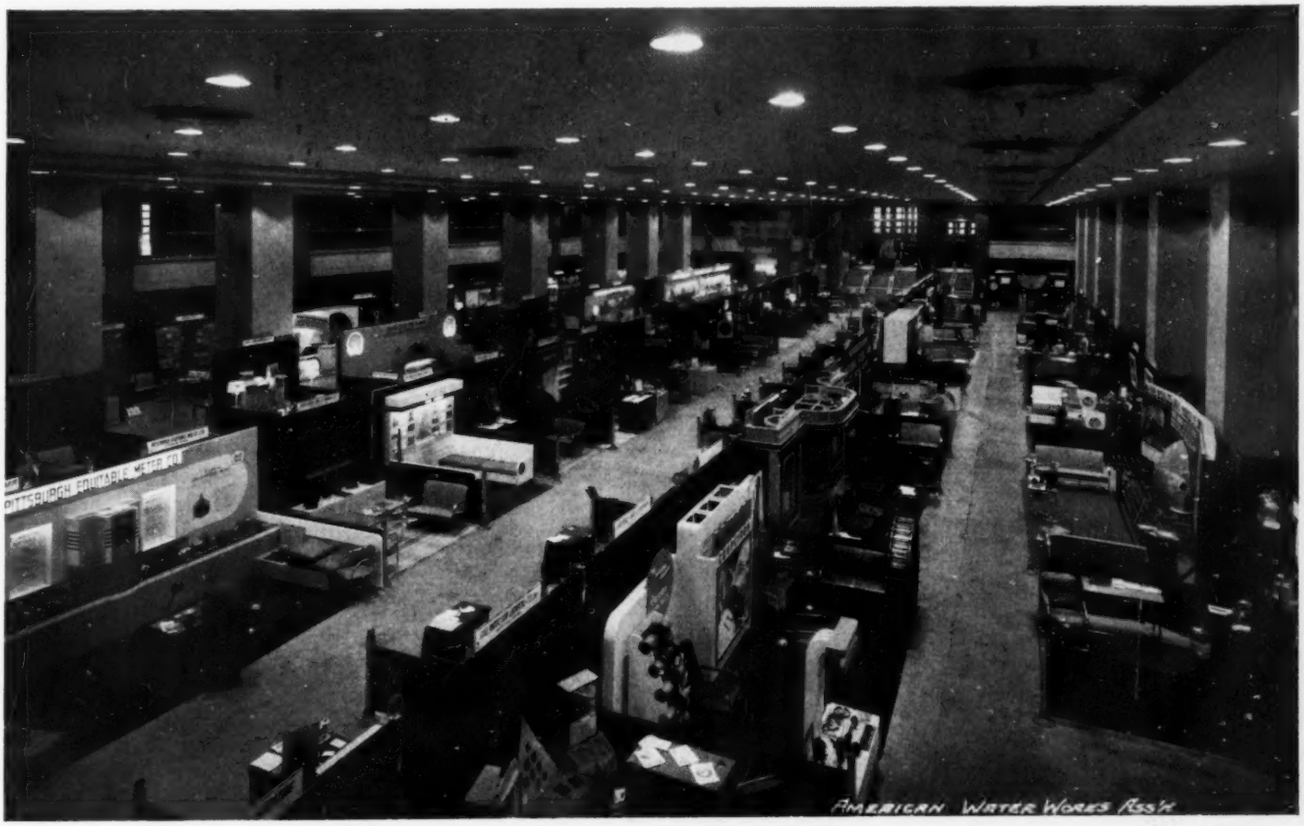
Water Works Mfgrs. Association

President*—Karl M. Mann (Case-Shepperd-Mann Corp.)
Vice-President*—Denis F. O'Brien (A. P. Smith Mfg. Co.)
Secretary—John A. Kienle (Mathieson Alkali Works)
Treasurer — Edgar A. Buttenheim (The American City)

Manufacturers Association Votes to Become Water and Sewage Works Mfgrs. Association

Before the Water Works Manufacturers Association, came an important question, which had prior to the meeting been the focal point for considerable argument. This question was that of broadening the activities of the Association, the membership of which already includes many firms that market equipment and materials in the sewerage field. The proposal to extend the usefulness of the present Association by changing it to the Water and Sewage Works Manufacturers Association, and thereby offer its facilities also to those firms who specialize wholly or practically so in the sewage and waste disposal field, had been carefully studied by a special Committee. Reporting for the Committee, W. J. Orchard, Chairman, recommended that the change be made, and offered specific recommendations covering three grades of membership—those interested in (1) Water only, (2) Sewage only, (3) Water and Sewage. After questions to the Committee and discussion from the floor, the vote was called. The result was a unanimous approval of the change. Before the act is legal,

*Takes office November 30th. Until then Col. W. F. Rockwell (Pittsburgh Equitable Meter Co.) continues as President of W.W.M.A., with Mr. Mann as Vice-President.



Manufacturer's Exhibits.
Proved the Best in A.W.W.A.'s History.

(1) *Chester Truman, Water Co. Sup't., Colorado Springs, and Mrs. T.*; (2) *Wesley W. Polk, Sup't. of Water & Public Wks., Evanston, Ill., and Mrs. Polk*; (3) *Pretty Jean La Mar, of Kansas City, does a nice job of plugging "Water Works and Sewerage" at our booth*; (4) *J. Burnie Stokes, Gen'l. Mgr. U. S. Pipe & Fdy. Co., and Mrs. Burnie*; (5) *W. J. Downer, Eng'r. State Dep't. Health, Springfield, Ill., and Mrs. D.*; (6) *E. A. Thibodeaux, Sup't. Water & Light, Thiboudaux, La., and Mrs. T.*

however, the revised constitution must be voted upon by letter ballot.

In this action another important recommendation by the Committee was also approved—namely, that of appropriating $5,000 which may be employed to assist the Federation of Sewage Works Associations and the Central States Sewage Works Association in financing the proposed National Convention which is being planned in conjunction with the Annual Meeting of the Central States Association in Chicago this Fall—the dates tentatively set being October 3-5.

Continued Growth and Expanded Service of A.W.W.A.

President Jensen, in his brief recounting of progress made by the Association, emphasized the marked amount and quality of work going forward through the many sub-committees of the Water Works Practice Committee, involving 58 items of procedure and specifications, applying to all phases of water works practice. The volume and quality of committee work completed in the last three years speaks for itself as indicative of the strides made under the leadership and energizing of Secretary Jordan and his headquarters staff.

Boasting the largest membership in its history, A.W.W.A. now has increased funds and facilities for continuing and expanding a splendid program for the benefits to the water works profession. Indicative of the continuing gain in strength through membership growth, President Jensen pointed out that 642 new members or reinstatements were recorded in 1939, and another 100 since January 1st, to make a new membership high of 3,809.

As to the magnitude of the business of A.W.W.A., President Jensen revealed that the Board of Directors had authorized expenditures for committee work and all other purposes during 1940 in the amount of $87,270.

In commenting on trends in water supply practices in general, Mr. Jensen emphasized the fact that the work of A.W.W.A. had proved of marked assistance to managers of water utilities in their efforts to meet the growing interests of consumers in water quality and a demand for improved quality and high degree of palatability and general attractiveness. Such interest growth proved highly encouraging to those in responsible charge of water supplies, since it presaged greater prestige for the water works fraternity and appreciation of the services of water works operators generally.

Technical Sessions

Following the President's opening remarks, the Technical Sessions got under way with brief reports from the more active of the Water Works Practice Committees, under Malcolm Pirnie as General Chairman.

Reporting on *Steel Pipe Specifications,* W. W. Hurlbut and his committee has put through 5 specifications with spectacular speed already, and 2 tentative specifications are soon to be published. Another fast moving committee is that on *Meter Specifications,* under S. F. Newkirk, which has already issued 2 drafts of specifications within the 18 months of its existence. It is believed that preliminary specifications on displacement meters will be ready by June 1st, and for compound meters by January 1st. As Chairman of *Committee on Tanks and Standpipes,* L. R. Howson stated that 1935 saw specifications for riveted construction completed. Now in its 5th draft were specifications for welded construction and the final draft should be ready during the convention. As Chairman of *Committee on Valves, Gates and Hydrants,* W. R. Conard reported no necessity of revisions had been indicated for the Specifications for Valves published in the May 1939 Journal. Now that the specifications dead-lock in the Joint Committee on Hydrants had been broken, such specifications had been approved by the New England members and were ready for publication. For Sluice Gates the first draft had been released and the final draft was to be expected during the convention. In the absence of Chairman Thos. H. Wiggin, Mr. Brush recalled that the Committee on C.I. Pipe and Fittings had completed a memorable piece of work extending over a 15 year period and costing roughly $500,000 to complete, the final results being the new specifications published in the December 1939 Journal.

Pipes for Water Works Use

(A Panel Discussion)

L. R. Howson pointed out that 90% of the footage of pipe purchased in all sizes is comprised of pipes of 12″ diameter and under. Whereas, the methods of specifying and purchasing the large size pipes for transmission mains usually involved study and recommendations by consultants, methods of purchasing the smaller sized pipes were not so satisfactory—with steel, cast-iron, and asbestos-cement pipe in the picture. The first consideration Mr. Howson put as that of *safety* (strength) with corrosion resistance next in order. Such considerations being insufficiently rec-

(1) *R. E. McDonnell and Chester A. Smith of Burns and McDonnell, Engrs., Kansas City.*—(2) *Past Pres. W. W. Hurlbut, Ass't. Ch. Engr. and Genl. Mgr., Bureau of Water, Los Angeles, and Lee H. Chamberlain, Mgr. Water Wks. Sales, Crane Co., Chicago.*—(3) *R. R. Hicks, Comm. Public Utilities, Windsor, Ontario, and Dr. A. E. Berry, Chief Engr., Provincial Dep't. of Health, Toronto.* (4) *Harry Hall, Chief Engr., and Carl A. Hechmer, Dep't Engr., Washington Suburban Sanitary Dist., Hyattsville, Md.*—(5) *From Maine came Howard Potter, Engr., Maine Public Utilities Comm., Augusta, and "Al" Read, Bangor's Sup't. of Water.*—(6) *Directors Sam Newkirk, Sup't. of Water at Elizabeth, N. J., and George A. Rohan, Sup't. at Waco, Texas.*

(1) *G. L. Fugate, Chief Eng'r., Water Dep't., Houston, Tex., a nd John B. Winder, Sup't. Water and Sewerage, Dallas, Tex.*; (2) *George Martin, President Water Comm. and Supt of Sewerage, Green Bay Wis., and Jeff Corydon, Pres., Proportioneers, Inc.*; (3) *Dave Morey, Cons. Eng'r., Dallas, Tex., and Harry Holmes, Eddy Valve Co.'s New York City Mgr.*; (4) *M. K. Tenny, Ass't. to Gen'l. Mgr., Des Moines Water Dep't., and Wm. O'Day, Chief Eng'r., Water Dep't., Coffeyville, Kan.*; (5) *J. Arthur Carr, Sup't. of Water, Ridgewood, N. J., and Jas C. Harding, Co nsulting Eng'r., New York City*; (6) *Tom. Quigley, Pardee Engineering Co., Chicago, and Marsden Smith, Chief En gr. Dept. of Water and Electricity, Richmond, Va.*

ognized, it was encouraging that the smaller size pipes were to be taken up by the committees.

W. W. Brush in reviewing the meaning of the new Specifications for Cast Iron Pipe to the purchaser and user, discussed four major considerations. The thickness of wall was primarily a matter providing adequate strength to withstand trench strains and shock of impact from heavy trucks, and the combination of such and internal pressure strains. It was his opinion that breaks in cast-iron mains were becoming fewer because better laying practices had prevailed and methods of protection given more adequate attention. The old blocking practice in pipe laying had been ruled out for pipes of 20 in. diameter and larger in favor of the flat bottom trench and pipe support by tamping. Concerning the question of internal pressures and water-hammer, it had been shown that only rarely had even water-hammer been responsible for breaks, and many other theories had been exploded in developing the new specifications. As to corrosion and tuberculation, while these effects had not been shown to weaken the pipes, to insure sustained carrying capacities some form of protective lining must be considered well justified when under present conditions such protection could be now had at little or no added cost.

"The Depreciation of Cast-Iron Mains as Related to Actual Service Lives" by REEVES NEWSOM, Consulting Engineer, and E. H. ALDRICH, Associate, New York City.

This paper presented facts which had come to light in a study of conditions of cast-iron mains of long service in Springfield, Mass., where completeness of 76 year records made possible some rather definite conclusions as to life expectancy of cast-iron pipes beyond anything yet developed. These studies represented a continuation of those reported on by Mr. Newsom before the 1939 Convention and since published in the Journal for October 1939.

The basic question which Messrs. Newsom and Aldrich raise is—"Why should mains with proven life expectancy of 100 years or longer be financed by bonds to be retired during a 30 year period?" In discussing the so-called "Straight Line Method" of financing new mains, the study and analysis produces evidence that this method gives 60 times the rate of debit retirement that seems justified when taking into account the actual observed depreciation values over a 76 year period. The result is that the apparent overall cost of furnishing consumers water during the first 15 years of use of the new mains is considerably higher than should be. Rate schedules built on this method of evaluating costs must therefore be considered erroneous.

In view of the unfairness of the "Straight Line Method," Mr. Newsom presented graphic analyses in support of his contention that the "Compound Interest Method" of amortization is much the fairer and sounder scheme. Basically, the method produces a consistent relationship between the residual value of the main and its complete service life, when considering evidence showing that 4-in. cast-iron mains have a service life of 50 years; 6-in. of 100 years; and larger sizes 150 years or more.

In his conclusions, Mr. Newsom advocates the greater fairness of the "Compound Interest Method" employing a 6% interest rate. Fact is, the method is not materially more complicated than the "Straight Line Method," which builds an undesirable reserve at too rapid rate and entails re-investment of funds. Mr. Newsom emphasized the fact that the argument applies to privately owned as well as municipally owned systems. (We regret that the best that can be done with the space available here is to give this sketchy digest of a paper that contains much deserving close study.—Ed.)

"Programming Equipment Replacement" by A. M. BRENNEKE, City Engineer, Denison, Texas.

Mr. Brenneke related experiences in studying the comparative value of the newer coagulants and mechanical flocculating devices at the Denison filter plant. Even though a relatively small plant, such studies had three times paid well in reductions of chemical costs. He advocated also the desirability of another form of saving—namely, face saving. In this he referred to study and application of the most effective measures to produce a finished product free of taste and odor as consistently as possible. In this direction he felt that super-chlorination, now called "break-point" chlorination, held great promise in producing consistent results.

In considering the value of equip-

(1) *I. M. Glace, Consulting Eng'r., Harrisburg, Pa. (Chairman of 4 States Section); L. J. Alexander, Eng'r., Southern California Water Co., Los Angeles; E. A. Rutledge, Vice-Pres., Rensselaer Valve Co., Troy, N. Y.* (2) *State Sanitary Engineers—T. A. Filipi (Nebraska), B. A. Poole (Indiana), W. W. Towne (South Dakota).* (3) *Lewis Birdsall, Mgr. Technical Sales, General Chemical Co., Chicago; Wm. T. Bailey, Chief Chemist, Water Dept'. Council Bluffs, Ia.; Ernest Boyce, Ch. Eng'r., Kansas Dep't. of Health, Lawrence, Kans.* (4) *Leon A. Smith, Sup't. of Water, Madison, Wis.; H. L. Londo, Sup't. Water, Green Bay, Wis.; Joseph Clusman, Sec'y. Water Commission, Green Bay, Wis.* (5) *From the "Old North State"—George S. Moore, Sup't. Water & Sewerage, Albermarle, N. C. (Chairman of the N. C. Section); W. E. Vest., Sup't. of Water and Sewerage, Charlotte, N. C.; Geo. S. Rawlins, Consulting Engr., Charlotte, N. C.*

On the A.W.W.A. Special to K. C.

(1) Walter Shea, Providence, and "Jim" Turner Supt. Water, East Providence, R. I.; (2) (3) The Chairman of Committee on Wells & Well Pumps, Arthur L. Carr, Sup't. Water, Ridgewood, N. J., has work to do while Sigworth starts a game of bridge; (4) Jimmy Angell sees that Leo Desmond of The Central Foundry Co. gets an eye full of "Water Works and Sewerage."

ment replacements, greatest possibilities in pronounced savings lay in pump replacements. In this direction the first requirement on which to base a decision must be adequate records for use in calculating existing wire-to-water efficiencies. In this direction an experience at Denison was cited. In studying the performance of 19 year old pumps, the records indicated that modern units could be installed and paid for out of power savings made during the first 3 years thereafter. In consequence, 4 units were replaced, regardless of the long life remaining in them.

The method of financing was very interesting, the seller accepting notes payable over a 10 year period. This debit was rapidly being retired from savings effected through reduced power bills.

Mr. Brenneke, being of the opinion that the continued operation of obsolete equipment constituted a definite indication of poor management, pointed out that "he who does so is actually paying for new equipment whether he gets it or not." This line of thought might well be emphasized to governing bodies that are reticent to approve expenditures for new equipment recommended by the department head.

George S. Rawlins, Consulting Engr., Charlotte, N. C., as a scheduled discussor recited experiences and results at Charlotte, N. C., which indicated the high cost of obsolescence and the net result of replacements. In 1936 it had seemed advisable and economically justifiable to install a 30″ pumping main in parallel with an existing 24″ main which was cleaned at the same time. Then it appeared feasible to replace the low service pump units. Results, proving the wisdom of the $362,722 expenditure (3.28% bonds), revealed annual net savings of $21,951 for the years 1937-1939 inclusive. Pumping an average of 7.43 m.g.d. before the change, the power cost had been $15.15 per m.g. as against a cost of $7.60 per m.g. for 7.95 m.g.d. average pumpage since—a saving of almost 50%. In terms of gallons pumped per K.W.H. the comparison was 663 gals./K.W.H. before and 1235 gals./K.W.H. since.

"Wichita's Water Supply Improvements," by R. E. LAWRENCE, Black and Veatch, Engineers, Kansas City.

Mr. Lawrence's paper described the new 32 m.g.d. water supply project of Wichita, Kansas, involving—(a) 25 gravel-wall type wells 150-200 ft. deep, equipped with remote controlled turbine pumps; (b) gathering lines from the wells delivering into a 28 mile long gravity supply main of 42″ and 48″ asphalt impregnated cement lined cast-iron pipes terminating at (c) a 32 m.g.d. iron removing filter plant located in the City near the existing privately owned Wichita Water Co. plant.

Perhaps the most interesting part of the project is the 28 mile supply main which functions as a gravity line from the well-fields and in which the largest centrifugally cast pipe yet produced (48″) was employed in 93,100 ft. of its length and 42″ pipe for 27,200 ft. of its upper end. It was the first pipe to be produced under the new A.W.W.A. Specifications for Cast Iron Pipe.

Laid on a relatively true hydraulic gradient at 32 m.g.d. flow, with a rather uniform slope from well field to filter plant, 130 ft. lower in elevation, an important consideration was the proper venting and valving of the line. To prevent entry of air into the line through automatic vacuum break and air-release valves, a cone valve ahead of the aerator set to maintain a minimum pressure on the line, is also controlled by water level in the basins. Thus, the supply main will at all times be kept full of water and under positive head throughout its entire length, and a relatively constant water level will be maintained through the filter plant, at all rates of demand. Several pressure relief valve batteries and 5 sectionalizing cone-type valves are located at studied intervals along the line.

Mr. Lawrence related in some detail the considerations given surge pressures, and live load and dead load (externally) in the design of this large diameter line. The net result was that more economical design in pipe tonnage was obtainable under the new and more exact specifications and more scientific safety factors now considered ample. For pipes larger than 24 inches water-hammer did not prove a consideration, in view of the surplus strength provided in designing for overburden loadings and impact from truck wheels. The paper reveals the specified tolerances in thickness of barrel, etc., for the several classes and sizes of pipes purchased. In computing pipe line capacities projected into the future the friction coefficients of C = 140 has been assumed for the cement lined pipes.

A study of surge control indicated that cone-type valves would preclude surge pressures greater than 20% rise above static. Such valves, supplied by the S. Morgan Smith Co., are located at the upper and lower end of the line and at 5 mile intervals. Pressure relief arrangements consist of one group of S. Morgan Smith 6″ angle type needle valves on the lower end of the 48″ line and a second group of 4″ needle valves at station 285 + 00 on the line just ahead of an automatic throttling cone valve. All well pumps are equipped with cone-type checks, adjustable for time of closure.

Operation of the 25 wells is controlled from the filter plant 22 to 30

On the A.W.W.A. Special to K. C.

R. E. Wagner of Zeolite Chemical Co. and Charlie Thomas, of Roberts Filter Mfg. Co.; (2) John Warde, Chairman of Committee on Transportation, Jack Diven of the Leadite Co. and Earle Biddle, who does a good job for the Penna. R. R.; (3) Mrs. Victor Arnold, of Staten Island, N. Y.; (4) Lincoln Van Gilder, Engr. & Supt. of Water, Atlantic City, en-route to receive the Fuller Award, and "Vic" E. Arnold, President, Phoenix Meter Co.

miles distant, through a 2 wire "Polaricode" supervisory control system, supplied by General Electric Co. The system involves 25 individual sub panels, at the filter plant central control station, to indicate all pertinent conditions at each well station.

The filter plant was briefly described as employing coke-tray aeration, lime treatment, coagulation and filtration at rates of 4 g.p.m./sq. ft. to remove 1 ppm. or thereabouts of iron.

The entire project will cost $2,425,000 (of which $1,091,250 represents a P.W.A. grant) and is being carried through by P. F. Brockway, Chief Engineer, and City Manager MacDonald, with Black & Veatch of Kansas City serving as designing and supervising engineers.

W. D. Moore, President of the American Cast Iron Pipe Co., which supplied the "Enameline" Pipe for the Wichita project, also commented on the fact that these were the first 48" pipes to be produced centrifugally and likewise the first production under the new A.W.W.A. specifications. The order, involving 6,000 lengths of pipe, had been produced as units not varying more than a maximum of 3% from the specified weight per length or 1% as the average for all lengths produced. A look at the records revealed that of the finished pipes 98.33% had met all specifications and were shipped. The average full length bursting pressure was 23,200 lbs. and modulus of rupture 50,800 lbs.

Mr. Moore also emphasized the greater economies effected in meeting the new A.W.W.A. specifications but related the careful chill tests and analysis for carbon, silica and phosphorus made of the melt at 2 hour intervals to insure the correct metal quality during production. He stated that if there ever were "tailor-made" pipes those for the Wichita project were certainly that, and all at a lower cost per foot of line than under former specifications.

Big Hats from the Rocky Mountain Section.

(1) *New A.W.W.A. Director O. J. Ripple, Denver's Supt. of Filtration with Geo. Turre, Chemist and Sanitary Engr. of the Water Department;* (2) *Small experimental "Accelator" Softening Unit at the Kansas City, Mo., Filter Plant;* (3) *Ben. Davis, Pipe Line Sup't. Rollins, Wyo.; "Bart" Edison, Hendric and Bothoff Supply Co., Denver, and "Jo" Brown, Crane Co., Denver.*

LEWIS CARPENTER LOSES A LONG HARD FIGHT

"Carp"

Lewis Van Carpenter, professor of sanitary engineering at New York University and director of the Sanitary Engineering Research Laboratory conducted cooperatively by the University and the City of New York, died of heart disease shortly before midnight Friday, May 10th, after a long hard fight to return to his teaching and directional work. He was 45 years old and is survived by the lovely and charming Tempie ("Domino") Carpenter, who he married in 1923.

One of the leading sanitary engineers and teachers of the nation, Professor Carpenter, when taken ill was directing important and large scale investigations in cooperation with the New York City Department of Sanitation and the Works Progress Administration.

Appointed to the staff of the University in 1935, Professor Carpenter was not only active in teaching and research work but a leader in the development of "short schools" for municipal plant operators and in sanitary engineering and allied fields.

Born in Wheeling, W. Va., in 1895, Lewis Carpenter attended the University of West Virginia where he received the degrees of bachelor and master of science in civil engineering. In 1926 he attended the University of Illinois where he was awarded the M. S. degree in sanitary engineering.

Appointed to the faculty of his *Alma Mater* in 1923, as an instructor, he advanced rapidly. He became professor of sanitary engineering in 1929 and three years later was appointed chairman of the department of civil engineering. Before he entered the field of education Professor Carpenter was active in commercial and municipal engineering.

He was a member of the Am. Water Works Association, which he served as chairman of several committees and member of its Board of Directors; the Am. Soc. of Civil Eng'rs; the Am. Public Health Ass'n; the Pennsylvania Sewage Operators' Ass'n; and the West Virginia Water Conference, in which he was long a wheel-horse and main-spring combined. He was an 18th degree Scottish Rite mason and a former monarch of the Grotto.

Professor Carpenter was an inspiring teacher, a dynamic lecturer and a sought after speaker. He was chosen by the University of Southern California to give a special course of lectures in the School of Public Administration. He was the author of many articles published in technical and professional journals. A frequent and valued contributor of articles to this magazine, the very last material that he ever prepared for publication was that from his sickbed which appeared in our Annual Review Number of January 1940 under the caption, "Developments and Progress in Water Supply During 1939."

When falling ill last November he had almost finished the work of compiling and editing the new "Manual of Water Quality and Treatment" for A.W.W.A., which was completed by H. E. Jordan, editor of the *A.W.W.A. Journal.* It seems odd that this publication should have issued barely in time for Professor Carpenter to hold it briefly in his hands and then lay it aside for others to pick up.

It is fitting that his name shall thus live on in the field he so well served.

[On the editorial page we have made space, while presses wait, to pay tribute and express our appraisal of Lewis Carpenter — a sterling fellow and inspiring friend.—L.H.E.]

LARVAE AND CRUSTACEA

Some Experiences With this Problem in Water Purification and Corrective Measures

By ROSS A. THUMA
Superintendent of Filtration
ST. PAUL, MINNESOTA

THE unusual things are generally the things that give one most concern. The presence of something new and different, the appearance of something that is not generally expected in water tends to create interest and excite curiosity.

In the summer of 1938 a rather strange stagnant odor appeared in the plant, resembling that of a stagnant pond in the "dog days" season. The filter sand became somewhat cemented together and a few cracks appeared, as well as some pulling of the sand from the filter walls. The oxygen content of the filter plant effluent (Table I) commenced to decrease to a very low oxygen content for lake water. The water arriving at the plant from the lake frequently carries quantities of algae, crustacea, larvae, and kindred biological material. Examination of the water in the filters after a few hours' service showed that the Phantom Mosquito Larvae — Chaoborus (Corethra) — were present in extraordinary numbers.

Table I

Dissolved Oxygen Content of the Water

1938	Plant Influent	Coagulation Basin	Plant Effluent
January	10.7	12.2	11.6
February	10.0	10.8	10.3
March	9.0	10.2	9.7
April	11.5	12.1	10.8
May	9.0	9.7	7.7
June	8.2	8.5	5.7
July	7.6	7.8	3.6
August	6.5	6.9	3.1*
September	6.2	7.1	3.3*
October	8.2	8.8	6.1
November	10.2	11.0	9.6
December	11.4	11.9	11.4

*Effluent from experimental filter plant during August and September contained 6.5 and 7.0 PPM of oxygen.

The Phantom Mosquito Larvae first made their appearance in the early part of July and continued to reproduce and thrive in the filters until September. The dissolved oxygen content of the water was reduced approximately fifty percent during the period that the larvae were present. The larvae doubtless played an important part in the reduction of the oxygen content of the water, but in what manner is not easily understood. It seems quite unlikely that the reduction of the oxygen content of the water was brought about by respiration of the larvae, for, if such had been the case, an increase in the carbon dioxide should have taken place. The carbon dioxide content of the water did not increase. The increased demand for oxygen during the period that the larvae inhabited the water was more probably due to an increase in the demand for oxidation of waste products derived from by-products of growth, development, and perchance, decay of the larvae.

The reduction in the oxygen content of the alum coagulated water from the plant was very definite and in striking contrast to the oxygen content of an experimental lime softening plant taking its raw water from the same source, and delivering an effluent with scarcely no reduction in the free oxygen content. The lime softened water did not pass through the aerator as the plant influent was required to do. The caustic lime treated water prevented the growth of the mosquito larvae, and, thereby passed through the purification process without reduction in the dissolved oxygen content of the water.

The presence of the Phantom Mosquito Larvae apparently was without any other effect on the quality of the water passing through the filters. The odor and taste of the water remained satisfactory, and so far as could be determined, the quality of the plant effluent was normal.

The period during which the larvae inhabited the filters was marked by: (1) A stagnant odor in the vicinity of the filters, but which did not pass through the filters, by (2) A cementing of the filter sand particles together. (3) A recession of the sand from the filter walls. (4) A pronounced reduction of the dissolved oxygen content in the filtered water.

The summer of 1938 marked the first appearance of the Phantom Mosquito Larvae in the water.

May-fly and Caddish-fly

Larvae of the Mayfly (Ephemerida) and the Caddishfly (Trichoptera) have entered the plant, causing odor within the plant and cementing of the filter sand upon different occasions. The larvae may enter the plant and remain in the filters for weeks at a time. During 1938 they were present in May and June but by Table 1 it can be observed that these larvae did not lower the oxygen content as did the Phantom Mosquito larvae. The problem of combating such pests is a difficult one, and control has only been partially accomplished in the St. Paul plant.

Larvae of Stonefly (Plecoptera) and Dragonflies and Damselflies (Odonata) have given trouble in the same way as the Mayfly and Caddishfly, but at infrequent intervals.

The Crustaceans

The crustaceans Daphnia and Cyclops have given an endless amount of difficulty in the purification plant. The organisms frequently invade the plant in very large numbers. They actually cover the surface of the water with their rafts, until it takes on the appearance of being covered with a film of dust or oil. At such times the water seems to be a moving mass of crustaceans. The ability of the crustacean to swim makes it practically impossible to precipitate the animals by alum "floc." Hence, it moves through the plant and eventually arrives on the filters. The downdraft of the water pulls these animals into the filter sand and very frequently it remains enmeshed in the sand, and is difficult to remove by back-washing. The influx of any considerable number of crustaceans will result in cementing the sand particles together, produces mud balls and cracks in the sand, and the bed pulls

away from the filter walls. The filter sand either fills up rapidly with the bodies of the crustaceans, necessitating frequent washing, or the sand is pasted together and pulled from the walls of the filter, requiring the filter to be washed to prevent the water from short circuiting around the sand bed. During periods of crustacea troubles the wash water requirement appears unreasonable. Where aluminum sulphate is used as a coagulant, very little can be done to prolong the filter runs or conserve the water used for filter washing. The situation may be relieved by a number of operating moves where equipment is available.

One Corrective Is Liming

The application of lime to the water in the lime softening process increases the alkalinity or causticity to a point where larvae and crustacea are killed. In consequence the treatment lightens the filter load, decreases the cementing of the sand grains, and prevents the pulling of the sand from the filter walls. Lime treatment, therefore, serves as an inexpensive as well as a practical method of eliminating difficulty from micro-organisms and larvae.

Fish "Planting" Another

Larvae and crustacea are the natural food supply for minnows and young fish and small fish in general. The crustaceans generally precede the small fish by two or three weeks in their arrival at the purification plant. The newly hatched fish appears to spend the larger portion of his time in eating, hence, with the arrival of the "fish fry" the larvae and crustaceans are drastically reduced in number. For several years it has been the practice of the Water Department to "plant" large numbers of minnows in the coagulation basin for the purpose of holding in check the crustaceans and larvae growth. This biological or "piscatorial" scheme of controlling the micro-organisms by the use of minnows and small fish has been uniformly successful in this plant. [If Mr. Thuma's plant was in the N. Y. Metropolitan Area he could make a tidy sum supplying his pets to tropical fish hatcheries at rates per gallon many times what he gets for the St. Paul water. —Ed.]

Chlorination, Still Another

The micro-organisms of the water may be controlled by high dosages of chlorine. Chlorine will kill the micro-organisms, but the chlorination products formed are of such nature that they are most difficult to remove from the water. In water containing a high amount of organic material the formation of mal odors and disagreeable tastes in the chlorinated water has precluded the practice from consideration. Experience in treating lake water containing algae or animal organisms has always resulted in the creation of material of such nature as to render the water unsuitable for drinking purposes. We have concluded that pre-chlorination is impractical as far as its application to the water in this plant is concerned.

Biologic Control the Best

The elimination of larvae, crustacae and even the micro-organisms by killing them is not always the best method. The dead organisms must be decomposed and disposed of, in which case mal odors and tastes are frequently developed in the water. The better procedure is to allow the organisms to find their way through the purification process without killing them. The biological method of destruction is much more satisfactory, wherein one type of organism devours another, thereby removing the possibility of mal odor and taste which results from the decomposition of their bodies.

The biological scheme introduces somewhat the idea of lake management, whereby attention is given to the cycles of micro-organisms, their food supply, growth and development. In a small lake capable of careful control many situations may be taken advantage of to create conditions that will tend to bring about a satisfactory development of the competing organisms.

RECREATIONAL USE OF WATER SUPPLY AREAS

(Correcting a Confusion of Reservoirs)

In our March issue appeared a report covering a Symposium on Recreational Use of Water Supply Areas held by the New Jersey Section of A.W.W.A. In the reservoir case at Boonton, N. J., there appears to have been some confusion of reservoirs, that in question being the reservoir for the Town of Boonton and not the Boonton Reservoir of the Jersey City system.

Our attention to the confusion, which creates an erroneous impression, the following has been brought to our attention in a letter from W. C. Mallalieu, Sanitary Engineer, Bureau of Water, Jersey City. The following paragraphs have been taken from Mr. Mallalieu's letter and we are only too happy to correct any erroneous impressions which the report may have created.

"Knowing your well deserved reputation for accuracy, I would like to invite your attention to some statements in the reporting of Mr. Brooks' paper which might cause some readers, unfamiliar with the actual conditions, to form a wrong impression of water supply sanitation in New Jersey.

In re the case mentioned on page 109 within the Jersey City catchment area, the facts were as follows: The Water Policy Commission issued a permit for the construction of a dam to create a lake for commercialized bathing over Jersey City's protest, this decision was appealed to the Supreme Court, which sustained the Commission's decision, on an appeal to the Court of Errors and Appeals the ruling was that the Commission was charged with the duty of protecting the sanitary quality of a water supply and the case was referred back to them for a rehearing, at the conclusion of which the Water Policy Commission rescinded its earlier permit and the dam was never constructed.

The subsequent case mentioned had no connection with the Jersey City reservoir as there stated; but involved the reservoir of the Town of Boonton, which lies theoretically within the limits of Jersey City's catchment area.

To protect Jersey City's interest under any possible contingency, I requested the developers to reserve a twenty-five (25) foot marginal strip around the proposed lake and upon their making this a matter of record with the Commission, Jersey City took no part in this case.

Regarding my own remarks in the symposium, the prohibition of bathing in potable supplies in New Jersey was not a matter of statute, but was a part of the state Sanitary Code, formulated by the New Jersey Department of Health. This forward step was cancelled by act of legislature (referred to in the report).

It can be seen from the above that in New Jersey the higher courts and the State Department of Health have not been remiss in their protection of the public health."

SOME CONSIDERATIONS TO THE QUESTION OF SLUDGE DENSITY

By GORDON J. WIEST
Chief Chemist
CHESTER SEWAGE WORKS
CHESTER, PA.

THE variation in sludge volumes with solids content changes determines the most effective use of sludge handling and other treatment facilities in a sewage treatment works.

In this all important consideration it is, of course, the amount of liquid mixed with the sludge solids that determines the volume to be handled, and since the volume varies so markedly with the percent of solid matter contained, this fact has a highly important significance to the sewage works operator and engineer. The effect extends to the operation of digestion tanks, concentration tanks, aeration units, pumping and piping facilities, sludge storage, and other treatment units.

It becomes apparent that all the efforts of a sewage works operator to secure a more concentrated sludge contribute sizeable dividends to plant efficiency and operating expense, when one considers that a rise in moisture content by a mere 2.5% means 100% more liquid volume to be handled per one hundred pounds of sludge solids, when the water content rises from 95% to 97.5%. By the same token a sludge of 99.5% water, as against 97%, has a volume 500% greater. When using as a base the same quantity of solids to be handled, a digesting sludge of 95% moisture occupies just one half the space of a sludge of 97.5% moisture. The significance of this matter is that the digestion period of the sludge may be doubled by what may look to be an insignificant decrease of only 2.5% water content. If a sludge with 95% moisture passes through a digester in a theoretical (calculated) time of thirty days, and the sludge becomes thinned to 97.5% moisture, two things happen to give a serious change in digester operation. These are:

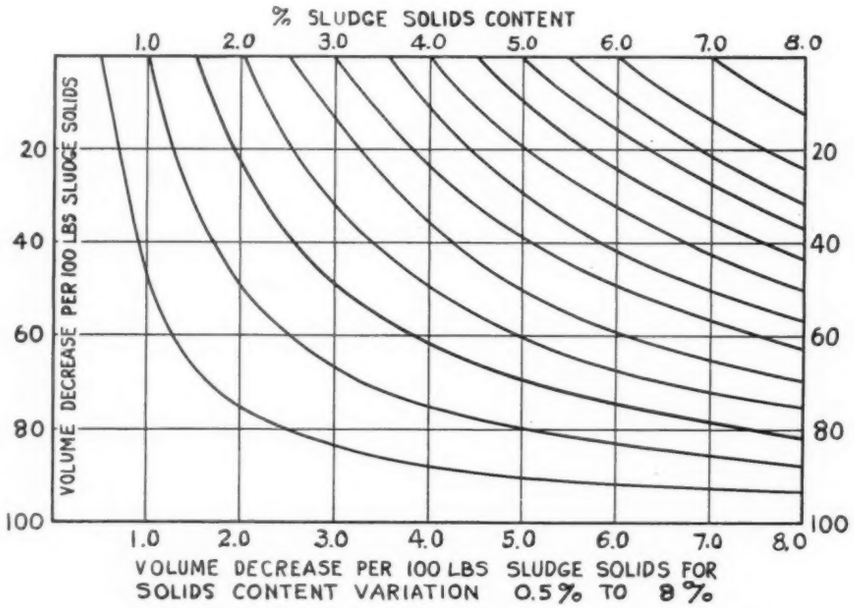
(1) The solids pass through the digester in one-half of the theoretical time (actually more nearly one-quarter of the time, due to disturbance of solids, dilution, and intermixing of new and old solids.)

(2) It will require approximately 100% more heat input to maintain a given temperature in the digestion tank because there is twice the volume of liquid to be raised to the desired temperature.

The marked changes due to a combination of these two effects are not hinted in the mere 2.5% more moisture content of the sludge which appears in the operating records. On the other hand if we recorded sludge concentration in terms of pounds of solids per 1000 gals., or the reverse, rather than percent solids, the volume relationship would become very much more evident to us in following operating records.

The relation of moisture content to the volume of sludge handled magnifies itself many times in activated sludge practice. For example, the difference between a sludge of 99.5% and 97% water is represented by a volume reduction of the magnitude of 6 volumes reduced to 1 and is of very real consequence and importance. The meaning of sludge volume decrease to an operator of an activated sludge plant may be easily evaluated upon a careful examination of operating data and any permissible measure of securing sludge concentration has high justification in improved operation and economy.

The accompanying graph shows the relation of sludge volume to solids content variations more fully than any number of words or further examples.



Curves Revealing the Marked Effect of Sludge Volume Reduction Through Concentration

(Note that by increasing solids content from 0.5% to 3.5% reduces volume by 600%. This in the Activated Sludge Process is of great significance.)

Ewing Galloway

April showers bring forth May flowers

THEY also bring an accumulation of impurities into the water supply necessitating constant supervision in order to deliver to the consumer a safe and palatable water at all times. High turbidities result from heavy run-offs of water; and tastes and odors occur from flushing out accumulations of leaves, decayed vegetation, etc., which have built up in swampy and stagnant areas over the winter season.

THIS is therefore a season of the year when trouble may come in big bunches. Make preparations now to take care of these problems by anticipating your chemical supplies; not forgetting AQUA NUCHAR, the Activated Carbon for taste and odor control.

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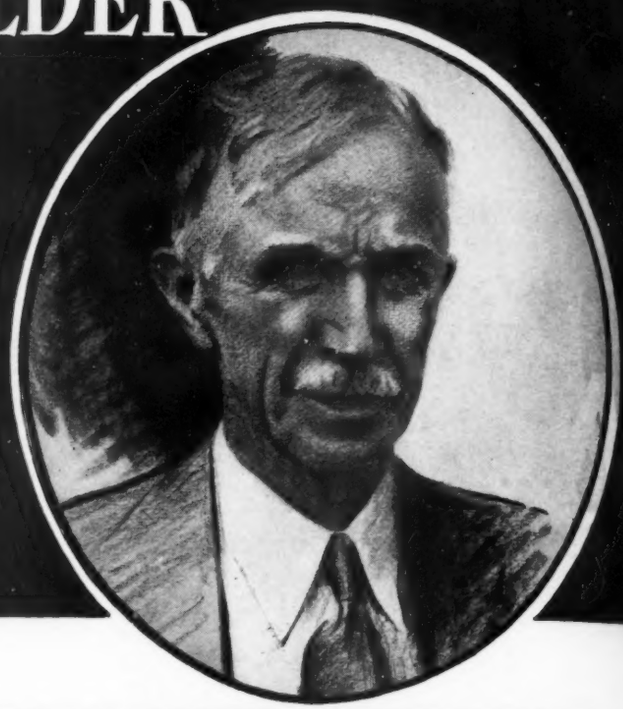
230 Park Avenue	35 E. Wacker Drive	1322 Widener Bldg.	417 Schofield Bldg.

NUCHAR → **AQUA NUCHAR**

LINCOLN VAN GILDER



LOW MAINTENANCE

is an economy feature of cast iron pipe that is proved by water works records the nation over. An impartial survey among 195 water works superintendents shows that the maintenance cost of cast iron pipe is far below that of any other pipe material which has been in use long enough for the recording of conclusive data.

LONG LIFE

Above is shown an unretouched photograph of a 118 year-old cast iron water main in Philadelphia—the oldest functioning water main in America. A tough and sturdy pipe, as engineers will testify who recently removed a section for museum purposes. The original "Public Tax Saver No. 1."

SALVAGE VALUE (upper left) Part of a half-century old cast iron water main in Springfield, Missouri, photographed after removal from the ground, ready for re-installation elsewhere in the distribution system. Cast marks were clearly discernible as was the original tar coating under a thin deposit of lime on the inside surface. Long life, low maintenance, salvage value—three tax-saving reasons for cast iron pipe.

Water mains represent about one-third of this country's 5-billion-dollar investment in public water supply systems. More than 98% of these mains are cast iron pipe with a *known* useful life at least double the *estimated* life of other water main materials. Because the tax-saving, through avoiding replacements, is enormous, cast iron pipe is known as Public Tax Saver No. 1.

Look for the "Q-Check" registered trade mark. Cast iron pipe is made in diameters from 1¼ to 84 inches.

CAST Q IRON

REPORT ON MAINTENANCE COSTS

R. L. LAWRENCE

(Superintendent and Chief Engineer, Water Works Department, Nashville, Tennessee)

"Although we have cast iron pipe in our system over 100 years of age, the only photographs available are of 24-inch pipe laid 59 years ago in the congested uptown section of the City. Several hundred feet of this line, which traversed the site of our new City-County Building, was recently removed and, being in excellent condition, will ultimately be placed back in service elsewhere. The maintenance cost per mile of this old line has been approximately $5.44 per year."

W. V. WEIR

(Superintendent and Chief Engineer of St. Louis County Water Company, University City, St. Louis, Mo.)

"Seven miles of 12-inch cast iron pipe, laid in 1903 between our plant and the distribution system, were replaced with 24-inch cast iron pipe in 1921. The salvaged pipe was immediately relaid as a primary distribution main, and in the 16 years I have been with the St. Louis County Water Company, has been repaired twice: once when a cloudburst undermined and dropped a concrete culvert on the main, and again when the supporting earth was washed away in a creek crossing. These 7 miles of 12-inch pipe, under pressures of well over 100 pounds in several places, have cost us less than $90 to maintain in these 16 years (slightly more than 80 cents per mile per year)."

D. L. ERICKSON

(Director, Department of Parks, Public Property and Improvements, Lincoln, Nebraska)

"The cost of maintenance of our Ashland supply pipe line—25.1 miles of 36-inch cast iron pipe—has averaged $9.64 per mile per year for the last 5 years. I wish to reiterate that the maintenance cost record for this supply line shows that no money so far has been spent on the cast iron pipe or joints in the line."

Wm. H. TRENTLAGE

(Commissioner Public Health and Safety and Superintendent of Water Dept., Elgin, Illinois)

"We have a 16" cast iron water main, laid in 1887, that extends from our pumping station to the elevated tank across the river, a distance of 2⅜ miles, on which we have spent only $22.03 for repairs and maintenance during the last 6 years, or $1.53 PER MILE. We recently removed 13,119 feet of small diameter cast iron mains that had been in service 52 years. These were replaced with larger cast iron mains and 12,900 feet of the old mains were relaid in outlying districts. The remaining 219 feet was sold for scrap iron."

High Water means high turbidity!

SPRING floods leave in their wake turbid water which calls for the use of Standard Silicate of Soda. Its use results in better flocculation and effects substantial savings in lime, alum and ferrous sulphate.

Our technical department will gladly help you in the use of the proper Standard Silicate for water clarification . . . Write!

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W-2

PACKINGHOUSE WASTE TREATMENT

As Provided by Armour & Co. in Plant at West Fargo, N. D., Featuring Multi-Stage High-Rate Filtration

By L. R. HOWSON, C.E.

ALVORD, BURDICK AND HOWSON, ENGRS.
CHICAGO, ILLINOIS

A PLANT for treating the wastes of the Armour and Company Packing Plant at West Fargo, North Dakota, was completed and placed in operation in March, 1938. This plant was built solely for the treatment of the packing wastes and the sanitary sewage of the employees.

A number of novel features are incorporated in the plant design, including—

(a) The use of trickling filters in multiple, the piping and pumping facilities being so arranged that the plant may be operated to provide either two-stage or three-stage filtration.

(b) The primary trickling filters are equipped with air and water wash and are operated at very high B.O.D. loadings. (5,000 to 6,000 lbs. B.O.D. /A.F./day.)

The Author*

*The author of this paper has the distinction of having just been installed as the new Vice-President of the American Water Works Association at the recent Kansas City Convention.

(c) Packing plant wastes have a very poor load factor. Accordingly, facilities are provided to store peak flows so as to equalize rates and strengths of wastes applied to the filters.

(d) The sludge is lagooned without digestion.

(e) The plant has demonstrated its ability to consistently remove more than 95% of the B.O.D. of the raw sewage.

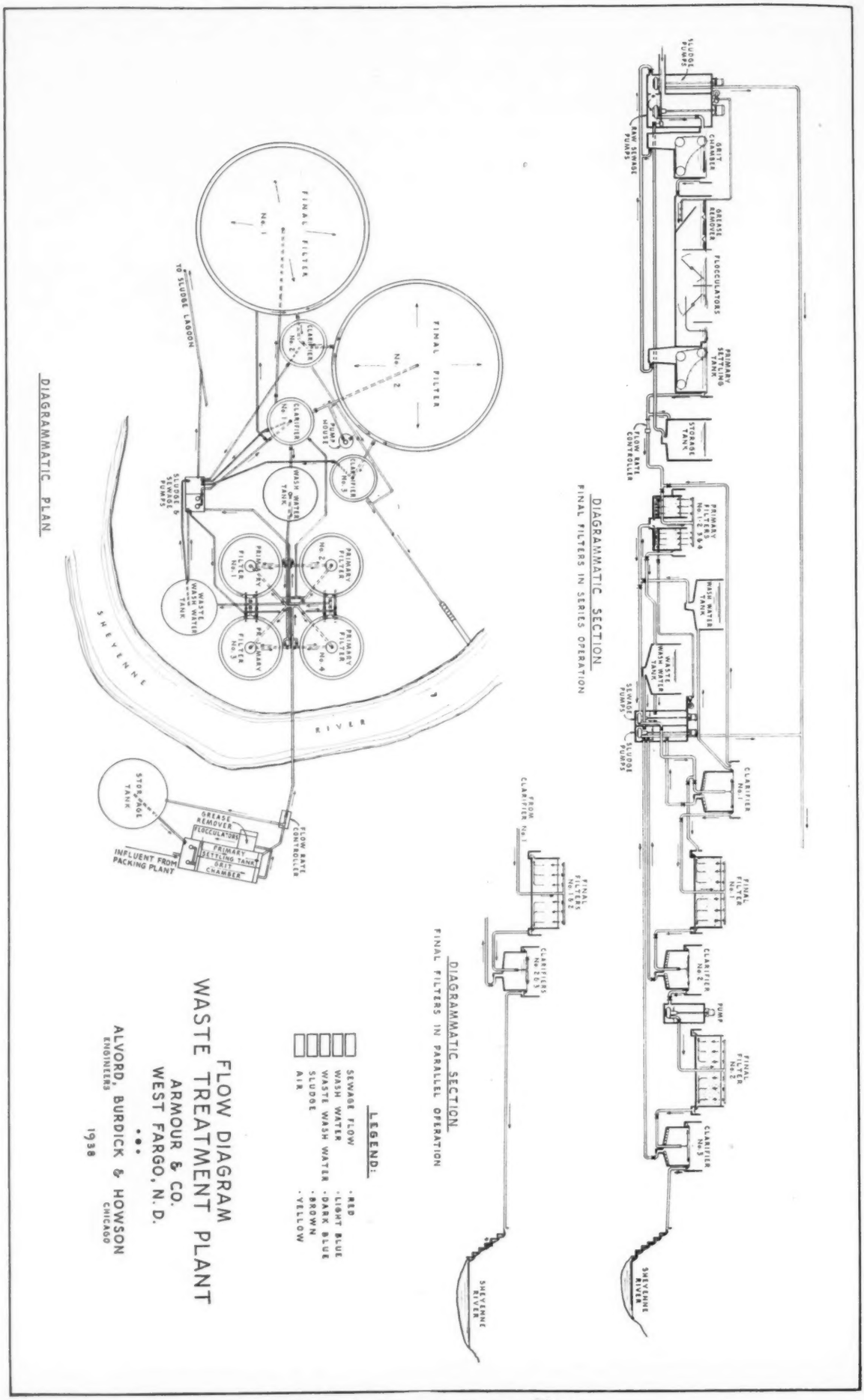
The meat packing industry has become famous for saving "everything except the squeal," but there is necessarily, in a development so vast, some economically unrecoverable waste. The West Fargo plant was designed to treat the waste of that character.

Local Requirements

In the design of industrial waste treatment plants as in the design of

The Waste Treatment Plant of Armour & Co., West Fargo, N. D.

1—*Fine Screens*
2—*Grit Basins*
3—*Grease Removal*
4—*Flocculation*
5—*Primary Settling*
6—*Primary Filters*
7—*Secondary Settling*
8—*Final Filters*
9—*Final Settling*
10—*Waste Storage Tank*
11—*Wash Water Tank*
12—*Dirty Wash Tank*



Flow Diagram of the Armour Plant

municipal plants the local requirements for treatment must be given primary consideration. The Armour and Company West Fargo plant is located on the Sheyenne River approximately 6 miles west of Fargo at a point where the River has a tributary drainage area of approximately 6,000 square miles. The river flows northerly from West Fargo about 10 miles where it joins the Red River which at the junction has a drainage area about equal to the Sheyenne. The Red River has been grossly polluted by the sewage of Fargo and Moorhead with a combined population of approximately 40,000 people. These cities also built trickling filter plants in 1937.

In normal periods of rainfall the Sheyenne River has had a well sustained flow. However, for the past ten years there has been a marked deficiency in rainfall over the area tributary to the Sheyenne with the result that the flow has been very much below normal, with a correspondingly lessened ability of the river to assimilate wastes.

Under the conditions currently prevailing at West Fargo the requirements for waste treatment are very stringent, they include—

(a) The removal of all solids tending to cause sludging in a practically stagnant stream.
(b) The removal of all scum and grease likely to foul the banks.
(c) A very high reduction in B.O.D. and the delivery of a stable effluent.

The plant built and operated by Armour and Co. has fully met all of these requirements.

The plant is designed to treat a waste of 700,000 g.p.d., of which about two-thirds is produced within a 10 hour period. The 5 day B.O.D. of the waste averages 1,000 p.p.m. giving a total of approximately 6,000 lbs. of B.O.D. per day to be handled by the treatment plant. The plant design was based upon the removal of 95% of the B.O.D. and this required performance has been consistently exceeded.

The Plant

While the particular installation at West Fargo has some novel features the plant is in reality an adaptation of previously demonstrated successful processes, some of which were first developed in the laboratory, then enlarged to plant scale size. At West Fargo the earlier accumulated background of experience in treating packinghouse wastes has been utilized and extended through the adaptation of improved mechanical equipment in order to secure the greatest flexibility of operations and uniformity of results.

One of the Primary Filters Undergoing Air-Wash

The pioneer plant, involving the principles of the West Fargo plant, was built for the Jacob E. Decker & Sons packing plant at Mason City, Iowa, this plant having been bought by Armour and Co. in 1935. The Mason City plant was in part the revamping of a previously built activated sludge plant. Since it represented a pioneer installation, it necessarily had its problems but proved to be a distinct step forward in the art of treating industrial wastes of packinghouse type. Through observation of the operations of the Mason City plant over a period of years, it was possible to avoid the same difficulties in the West Fargo design.

In the early years of the drought at West Fargo preliminary treatment consisting of fine screens for the removal of paunch contents and settling tanks, provided with mechanical cleaning facilities for sludge removal, were installed. With the persistency of the drought however, it was decided to provide more complete treatment and in 1937 plans were drawn for the revamping of the tanks so as to provide grit removal prior to grease flotation; thereafter, flocculation and settling and to secure any desired reduction in loadings on the secondary treatment process. The West Fargo plant now consists essentially of the following steps:—

(1) Fine Screens
(2) Grit removal
(3) Grease flotation
(4) Flocculation
(5) Primary Settling
(6) Primary trickling filters (washable)
(7) Secondary Settling
(8) Final Trickling Filters (two units, which may be operated in series or parallel)
(9) Final Settling
(10) Discharge to river over aerating cascade.

A schematic diagram of the plant is presented for reference.

Fine Screens

The fine screens are of the North revolving drum type, having narrow slotted openings. The fine screenings consist mainly of paunch contents, such as broken hay, grains of corn, oats, etc. This material is hauled away by cart to a dump and used as filling. This method of disposal has long proved inoffensive.

Grit and Sludge Settling

The grit chamber is one of the two original settling basins. Prior to the addition of secondary treatment there were two settling basins operating in parallel. The new plant design provided grease flotation and flocculation and so rearranged piping as to operate the settling tanks in series. Between the two tanks grease flotation and flocculation is provided. This was done to prevent the deposition of heavy gritty material in the grease and flocculation basins. In the present flow sheet one of the settling tanks serves as a grit chamber, its effluent flowing progressively through the grease flotation tank, the flocculation tank and the second of the original settling tanks.

The grit tank and settling tank each provide approximately 30 minutes period of retention. With the heavy character of packinghouse sewage this series of tanks removes about 90% of settleable solids and 35% to 40% of the B.O.D.

The sludge from both the grit and settling tanks is pumped through a 4" cast-iron pipe line to low lying land across the river from the pumping station, a distance of some 500 to 700 feet from the point where the sludge is settled out. This overhead

line is supported by trestle and has a continuous slope towards the sludge lagoons. Sludge has been lagooned at West Fargo for more than five years without nuisance, and with very little difficulty due to freezing in the sludge discharge line. It is however, necessary during cold weather to be sure that the line is blown out and drained after each sludge pumping.

The sludge air dries to a fibrous cake, resembling in appearance sludge bed dried digested domestic sludge. It is odorless, and in all respects resembles well digested domestic sludge. However, this sludge has had *no digestion* in tanks and is simply pumped from the first and second settling tanks direct to the lagoon. Due to the fact that the waste has a suspended solids content of from 800 to 1,000 p.p.m. the accumulation of sludge is quite fast. In the five years an area of some 4 or 5 acres has had its level raised several feet.

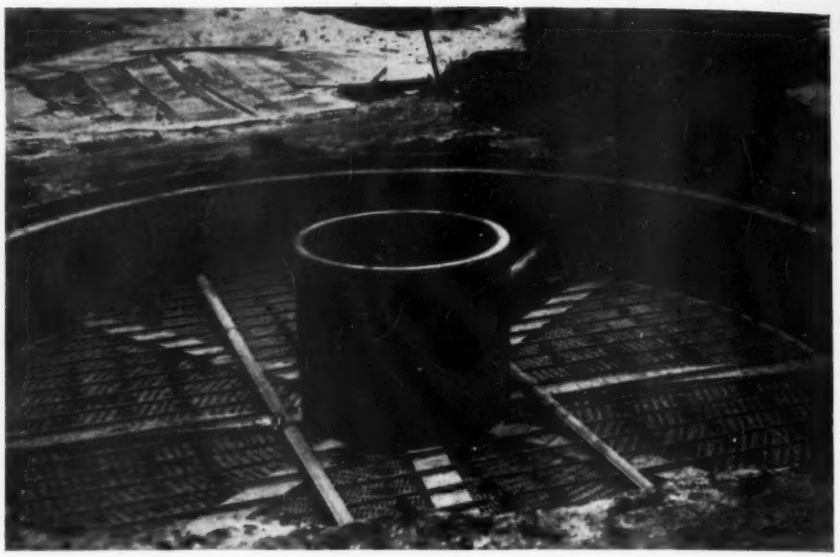
The West Fargo experience with lagooning sludge checks the longer experience at Mason City and Fort Worth, where packing house sludge has been lagooned without digestion successfully for many years.

The pumping station, grit chamber, settling tank and flocculators, as well as the storage tank, are located on the East bank of the Sheyenne River. On account of the lack of space it was necessary to build the remainder of the new work across the river. i. e., on the west side of the Sheyenne River.

Grease Flotation

All packing plant waste contains grease. Grease is a valuable by-product, and every effort is made to recover as much as possible. However, due to the relatively warm temperature of the water much of this grease is in a state of emulsion and is not, therefore, practicable of separation economically.

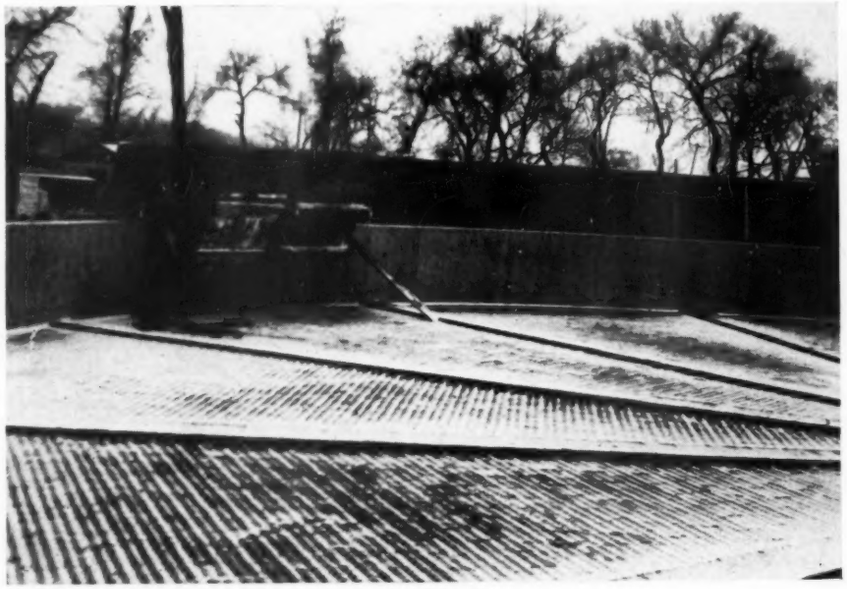
At West Fargo, in addition to passage through the conventional packinghouse type baffled "catch basin," attempt is made to recover additional grease in a specially designed basin, involving flotation with compressed air. The air is admitted through a perforated grid in the bottom of the grease flotation tank which is divided into two compartments separated from each other by an inclined baffle. The first compartment in which the air perforated pipe grid is placed has a large bottom area and a small top. The contents of the first compartment are kept well agitated in order to prevent depositing of the grease. The other compartment is small at the bottom and large at the top, the purpose being to provide a large area for the accumulation of grease where it will coalesce and from which it can be skimmed and disposed of. The bottom is made small to prevent sludge deposits. The period of retention in the grease compartment is approximately 15 minutes, divided equally between the aeration and the coalescing periods.



One of the Washable Primary Filters
Floor of vitrified Armcre tile block, above which is the air-wash perforated piping. Note center well for water-wash. Loadings on these high-rate units are 5,000 *to* 6,000 *lbs. of B.O.D. per acre-ft./day.*

Flocculation Compartment

Observations of packinghouse waste indicated that some increase in settling efficiency and in B.O.D. can usually be effected by slow mechanical mixing. Accordingly a flocculation chamber providing approximately 40 minutes detention was provided in the West Fargo installation. The flocculators consist of three paddles in series, each on a separate shaft and all shafts parallel. When the plant first went into operation there was some tendency for sludging between the flocculator paddle wheels. This was overcome by removing the heavy grit prior to flocculation and, further, by lengthening the flocculator paddle vanes. In actual operation the intermediate flocculation, without chemicals, has demonstrated its ability to increased the B.O.D. removal through the tanks by about 5%.



Vitrified Block and Channel Floor Construction of Final Filters
These units operate as ordinary trickling filters handling the waste after reduction of B.O.D. to between 250 *and* 350 *ppm. at rate of* 1.4 *m.g.d./acre.*

Storage Tank Operation

Packing plants usually arrange their killing schedules so that the peak water use occurs within a 10 hour period, although there is considerable water used during the entire 24 hours. Hourly weir measurements made of the flow in the outfall sewer indicated that a storage tank of capacity equivalent to approximately 20% of the day's flow would equalize the flow. This tank would store waste of the greatest concentration.

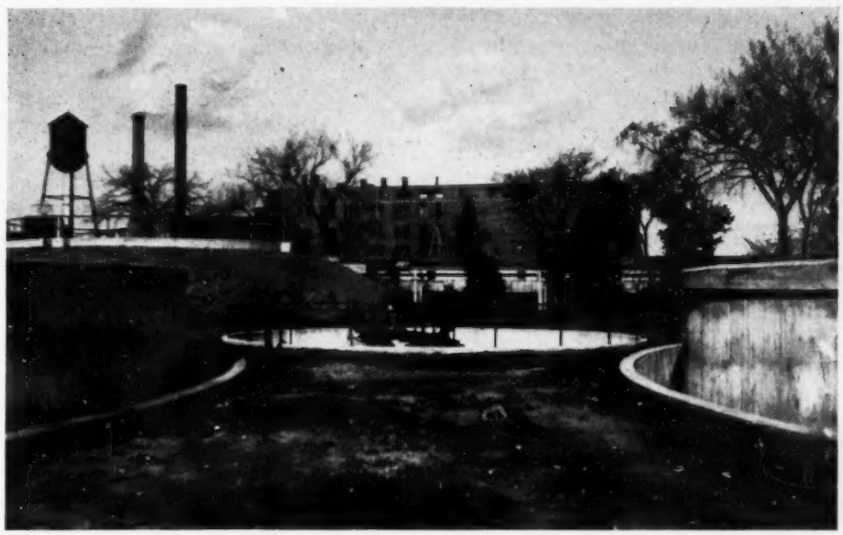
In view of the desirability of having the load on the filters as nearly uniform in quantity and quality as practicable a storage tank of 150,000 gallons was provided. In operation this is utilized as follows:

During hours of heavy waste production the flow in excess of the average 24 hour rate is diverted to the storage tank. This is automatically accomplished by installing an ordinary water works type rate controller between the settling tank and the primary filters. The controller arm is set at a predetermined rate of approximately the 24 hour average for the particular day. During hours of heavy flow the surplus goes to the storage tank. Another line leads from the storage tank to the pump suction well. A float valve in the pump suction well is so installed that when the water in the suction well drops below a predetermined level sewage from the storage tank is returned to the pump suction and the flow is thus maintained uniform. In this way not only is the quantity of flow equalized over the 24 hours, but by storing a considerable portion of the concentrated day load to mix with the more dilute night flow the loading on the secondary parts of the treatment plant is also much better equalized.

It was anticipated there might be some difficulty with sludging in the storage tank. However, its operation has been entirely free from deposits, even though the bottom of the storage tank has a slope of but 12 inches in 25 feet radius. The tank's operation has been entirely automatic and it has required no cleaning. It is doubted whether the plant could operate with anything like its efficiency without this storage tank.

Primary Filters

After passing through the water works controller the settled waste is discharged to the primary filters, which are four in number, each 42 feet in diameter and with a six foot rock depth. The rock varies in size from 1″ to 2″; it is of crushed granite carefully cleaned and graded. The filters are of the washable type, each provided with piping and facilities by which, when desired, the influent may be shut off and the flow reversed for washing the stone, either with water alone or in conjunction with air. An accompanying picture shows one of these units receiving a backwash.



Looking at the Armour Packing Plant from Between the Two Final Filters
The banked unit on left is the intermediate clarifier; in foreground, the final clarifier; beyond is the elevated sludge line.

For purposes of washing, as well as for ventilation, a center well is provided in each of the primary filters. This well is 8 feet in diameter and extends 2 feet above the top of the filter stone. The wash water is admitted to this center well and thence through the underdrain system, washing upwards through the rock and thence to an outer wall peripheral wash water trough.

Air Wash System

The floor of the filters is built of Armcre Vitrified Tile block which has a large proportion of open area for ventilation and drainage. The air for back washing is admitted through a pipe grillage system consisting of 1½″ pipe laid at 18″ centers with ¼″ orifices set in the bottom at 18″ spacing. An air compressor operating under 3 lbs. pressure, and with a capacity of 2,000 cu. ft. of free air per minute, furnishes the air for the air wash. This is equivalent to approximately 1½ cu. ft. of free air per minute per square foot of filter area being washed. (See cut.)

Water Wash System

The water for backwashing the filters is furnished from a water storage tank of 50,000 gallons, elevated so as to provide sufficient head to deliver the water in large volumes to the filter being washed. The piping from the wash water tank to the center well of the filters is designed to deliver 5,000 gallons per minute the equivalent of 4 gals./sq. ft. of filter surface. The filters are washed one at a time.

The dirty water from filter washing passes over the peripheral weir around the edge of the primary filter and thus to a second storage tank, also of 50,000 gallons capacity, provided for the purpose of settling out the material washed from the filter stone. After quiescent settling the supernatant liquor is pumped to the clarifier tank and thence passes through the remainder of the plant. The sludge is pumped to the sludge lagoon.

It has been found practicable to extend backwashing of the primary filters to intervals of 2 to 3 weeks, thus the dirty water sedimentation tank is required for washing purposes only a small portion of the time. At other periods this unit is used as a sludge thickening and concentration tank in order to minimize the amount of water pumped to the sludge lagoon.

Filter Loadings and Performance

Observation of the filters before washing indicate that there is a heavy gelatinous film or growth of jelly like consistency extending the entire depth of the filters. Under such conditions it is rather remarkable that the filters have been maintained entirely free from pooling.

These units are operated at high rate, approximately 6 million gallons per acre per day and have consistently demonstrated their ability to remove high loadings of B.O.D. When loaded at rates of from 5,000 to 6,000 lbs. of B.O.D. per acre/ft. per day they

have removed from 3,000 to 4,000 lbs. In other words, by the time the waste has passed through the primary clarifiers, the primary filters and their settling tanks the B.O.D. of the raw sewage has been reduced from approximately 1,000 p.p.m. to from 250 to 350 p.p.m.

Another interesting point in connection with these washable filters is that after each wash they seem to pick up their efficiency almost at once. It was also found when the plant was first placed in operation, even though that was in the middle of March in a very cold climate, the filters picked up their efficiency at a very early date, due probably in large part to the fact that the waste is warm, its temperature normally averaging about 80 to 85° F. This high temperature should also have a very beneficial effect in creating up-flow of air through the beds. This fact may account, in part, for their ability to take such heavy loadings successfully.

Sewage Pumping Station

The effluent from the primary filters passes to the suction well of the sewage pumping station, from which it is lifted to a clarifier for settling before passing to the secondary filters. The pumps installed in this station are of vertical motor driven type, two in number, each having a capacity of 650 gallons per minute. They are substantially duplicates of the pumps in the raw sewage pumping station, east of the river. The sewage pump station also houses the sludge pumping equipment and the air compressor which is used in backwashing the primary filters.

Intermediate Clarifier

The intermediate clarifier is of the si-feed radial flow type. It settles the effluent from the primary filters enroute to the secondary filters. The settling period is approximately 1 hour. The sludge from this clarifier is drawn to the sludge compartment of the pumping station from which it is delivered to the sludge lagoon or the concentration tank, as may be desired.

Final Filters

The final filters are two in number, each 120 ft. in diamater with a rock depth of 6 ft. They are so arranged that they can be operated either in parallel or in series. When operated in parallel each is dosed at the rate of approximately 1.4 million gallons per acre day. When operated in series the rate is of course doubled or approximately 2.8 mgd. per acre. The secondary filters are of conventional domestic trickling filter design; they are provided with Armcre Vitrified Tile block floor with radial drains to the effluent gutter built around the outside wall.

When the filters are operated in series the effluent from the first filter goes to a second clarifier from which it is pumped to the third filter by equipment which is a duplicate of and in step with equipment in the other two pumping stations.

The final filters are ordinarily operated in parallel; at all such times one pumping station and one clarifier are out of service.

The effluent from the final clarifier is discharged over a cascade step with a drop of approximately 8 ft.

Winter Operation Difficulty

Fargo is located near the Canadian line in a very cold latitude. Winters are very severe, temperatures of 30 to 40° below zero F. being frequent. It was anticipated that there might be some difficulty in keeping the secondary filters operating under the coldest weather conditions. In order to ascertain the probabilities in this respect systematic observations of the air, influent and effluent temperatures were made over a considerable period of time. These indicated that, while no winter protection would probably be necessary, as a precautionary measure it was desirable to protect the secondary filters in some degree from the cold wind blowing across them. This was done by building a wood fence approximately 6 ft. high inclosing the filters and acting as a wind break. Steam also was provided for heating the sewage prior to its application on the secondary filter and this has actually been used occasionally during periods of extremely low temperature. There has not been a single interruption in service in the complete treatment of the Fargo plant waste in the year and a half of its operation.

Personnel

The waste treatment plant was designed by Alvord, Burdick & Howson of Chicago with the cooperation of Dr. Max Levine of Iowa State College, Ames and Dr. W. C. Moor for many years in charge of the Fort Worth, Texas packing house waste treatment plant. Much of the success of the operation of this plant is due to the close laboratory control and its excellent operation under Armour supervision.

The construction of this plant is an example of what can be done under severe winter conditions when employing properly protected construction plant layouts. The contract was let the latter part of October, 1937. The construction was completed and the plant placed in operation by the middle of March, 1938. The work was so well protected that no concrete was damaged by freezing and the character of the work, its finish and appearance is a credit to the contractor having the work in charge. The work was built by Meinecke-Johnson of Fargo as general contractor.

The rotating distributors on the filters were supplied by the American Well Works. The drag line equipment in the primary settling and in the grit tank was supplied by the Link Belt Co. The flocculating units and the equipment for all circular clarifiers was supplied by the Dorr Co.

A CORRECTION AND AN APOLOGY

A Correction and an Apology

In the report covering the Silver Anniversary Convention of the New Jersey Sewage Works Association, on page 157 of our April issue, we have credited Mr. Theodore Eggertson with being Superintendent of Sewers and Treatment Works, New Brunswick, N. J. On page 164 the same mistake appears in connection with the digest of Mr. Eggertson's paper on "Sludge and Scum Preheating Ahead of Digestion."

We exceedingly deplore this mistake. Mr. D. M. Vail is Supervising Engineer of the New Brunswick, N. J. plant and Mr. Eggertson is Sup't. of the Raritan Township Sewage Treatment Plant. This error occurred as the result of the fact that Mr. Eggertson's address, as shown on the printed convention program and the registration list, is New Brunswick. Although this is correct he has no connection with the New Brunswick plant.

The statements made in connection with methods of operation of the Raritan Township Plant are accurate, the confusion being in crediting such to the New Brunswick plant. Our apologies to Messrs. Eggertson and Vail for this very thinly alibied mistake.

LINING CAST IRON MAINS IN PLACE WITH CEMENT MORTAR*

Experiences and Results at Charleston, S. C.

By JAMES E. GIBSON†

Manager and Engineer

WATER DEPARTMENT,

CHARLESTON, S. C.

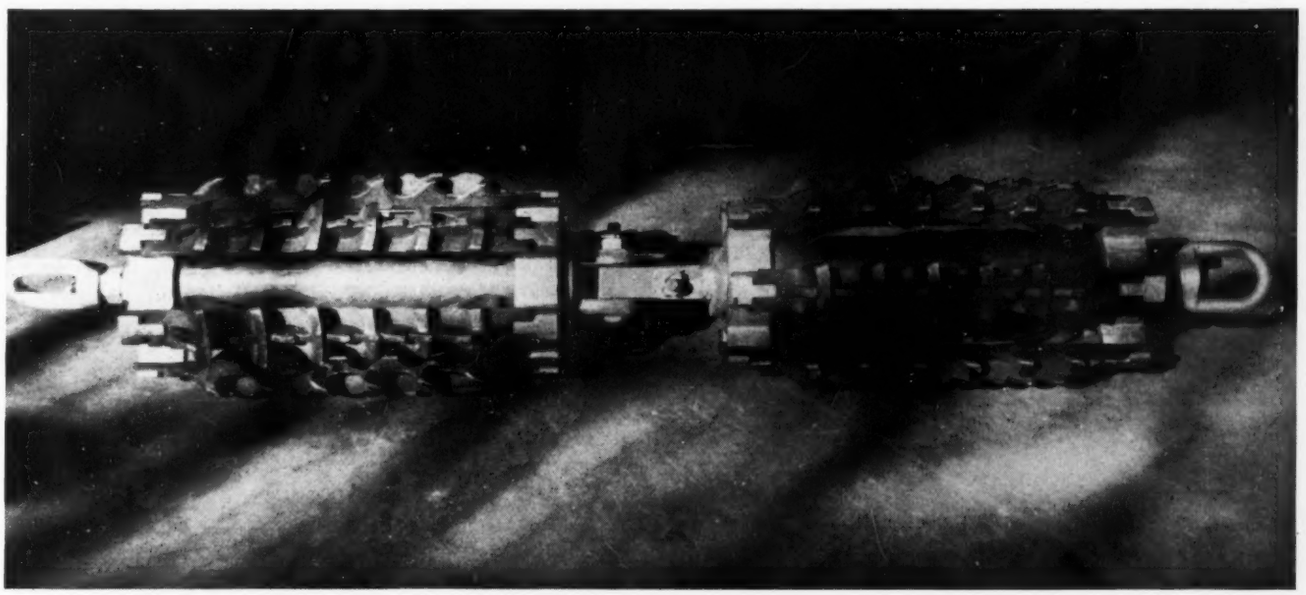
CEMENT mortar lined and encased sheet iron and steel riveted water mains, and cement-mortar lined wrought-iron and steel service pipes have been in use in the United States, particularly in the New England States, for near unto one hundred years and are still giving good service. It was not until 1922, however, that the practice of cement-mortar lining of cast-iron water mains was introduced. The use of cement-lined and encased sheet iron water mains was more than likely dictated by the high cost of the cast-iron bell and spigot pipe of that time. The increasing demand and improvement in the manufacture, perfected by the pipe foundries, soon overcame the price differences in the two materials, so that by the late nineties the manufacture of cement-lined sheet steel pipe had almost ceased, the last company making this type of pipe being the American Pipe and Construction Company of Philadelphia, Pennsylvania, with which company I was associated as assistant engineer to the late J. W. Ledoux, Chief Engineer.

The Author

Experience gained and flow tests made on cement-lined wrought-iron pipe as manufactured by this company, in comparison with tests on cast-iron mains of the same age laid in the same system and carrying the same water, showed the superiority of the cement-lined mains over the cast-iron mains. It was this experience that led me to propose to the Commissioners of Public Works of the City of Charleston, South Carolina, in 1921, that standard cast-iron water mains could with profit be lined with cement mortar. We received favorable consideration from the pipe foundries to our suggestions, and in June, 1922, in cooperation with the American Cast Iron Pipe Company of Birmingham, Alabama, began experimenting with the lining of standard cast-iron pipe with cement mortar. During the fall of 1922, the Charleston Water Department laid some ten miles of cement-lined cast-

†Honorary Member of A.W.W.A.

*A paper read before the 60th Annual Convention of the American Water Works Association, and here printed by permission of the Association.



Tate Self-Sharpening Cutting Scrapers

Elliptical Springs Hold Cutter Blades Against Pipe Walls

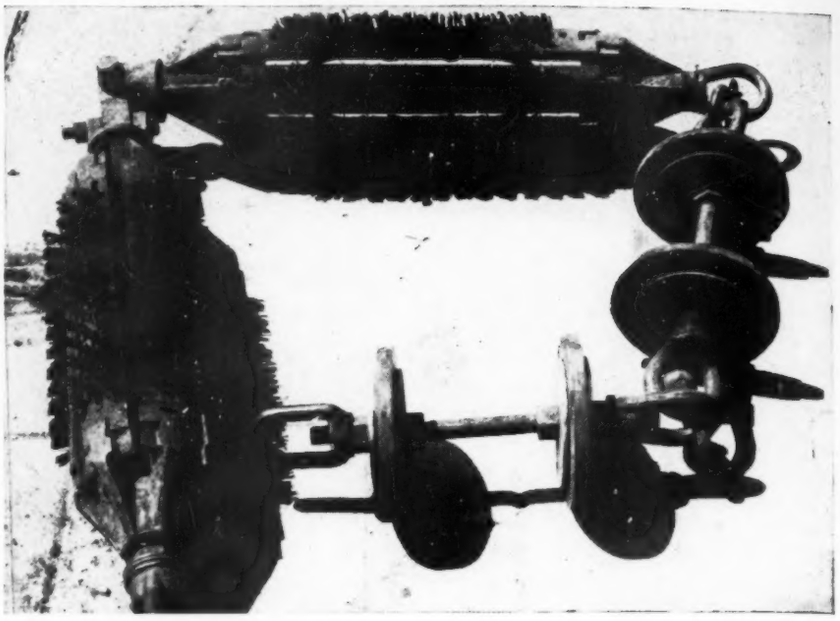
iron pipe from 4″ to 24″ diameter.[1] Tests made immediately after laying this pipe in 1922, to determine the value of "C" (Williams' and Hazen's formula), gave values as high as 140 and averaged 135; and further tests within the last eighteen months show that these values have not depreciated, and in a few instances have improved. Based on observations, if the lining does not exceed ⅛″ thickness, coefficients of 140 may be conservatively used for cement-lined cast-iron mains, even when based on the nominal diameter of the pipe.

The cleaning of tuberculated cast-iron water mains has been practiced for the last thirty or forty years, but experience gained has shown that, with many soft active waters, cleaning must be repeated at varying intervals, and, thereby, constitutes a recurring expense and an annoyance to the water consumers.

The executives of the Charleston Water Department, faced with their disappointing results from the cleaning of mains, and with their excellent experience with the cement-mortar lined mains, began to look for some practical method of protection of the exposed interior surface of the water main after cleaning.

A Method Becomes Available

In about 1930, Mr. William Taren Tate of Sydney, Australia, began experiments with a process to cement-mortar line cast-iron mains in place, and in March, 1932, was granted Australian patents covering his process, and began the actual lining of mains in the Sydney Metropolitan Water Supply and Sewerage District. At the close of the year 1935 approximately 89 miles of mains had been lined in place and by the end of the year 1938 over 600 miles had been completed; and to date over 1,000 miles. In 1934, Mr. Tate demonstrated his process of lining mains in place to the Water Works Commission of Manchester, England. A description of the work done at Manchester, was given in a paper by Mr. Thomas Wiggin, Consulting Engineer of New York City, presented before the American Water Works Association in 1935.[2] It was thus that our attention was directed to the Tate process of lining. The Tate Pipe Linings, Inc., of Andover, Massachusetts, was incorporated October 25, 1938, by Mr. E. H. Lewis of Andover, president, who obtained the license for the use of the Tate patents in the United States. Mr. Bruce Harkness of this latter company read a paper in February, 1939, before the New England Water Works Association,[3] giving his experience in lining water mains under the Tate patents, particularly in England and in Buenos Aires, Argentina. Later he took up with us the proposition of lining mains in Charleston, South Carolina.



Wire Bristle Cleaning Brushes and Squeegees

As a result of the information gained from the above papers, and a study of the process and equipment as presented to us by Mr. Harkness, the Water Department of the City of Charleston entered into a contract in July, 1939, for a trial lining of about 2½ miles of 4″, 6″, and 8″ water mains in the system. It is the work done under this contract that this paper describes.

Equipment and Procedure

The procedure of cleaning and lining is: First, the section of main to be cleaned is isolated from the rest of the system, and to take care of the consumers, if numerous, a small service main is laid along the gutter or curb in the street with outlets provided for each house service. This temporary service main is then connected to the water main at convenient locations, preferably back of valves in the section to be cleaned. If valves are not available then the main must be cut and plugged so as to take care of the feed to the temporary main without interference with the work. The street is then opened at all service connections and all services are disconnected. A section of rubber hose is inserted between the service pipe and the temporary main at the gutter, so that during the interval of cleaning and lining the consumers receive water through the temporary main and the flexible hose connecting it to their regular service lines. When there are only a few consumers on the main being lined, water can be supplied them through the use of large containers delivered by truck. Next, all hydrant leads, tees, and cross-mains are disconnected from the section to be cleaned. The main at each end of the section to be cleaned (usually about 300 to 400 feet in length), is then cut so as to permit the introduction of the cleaning apparatus. By means of sewer rods or steel tape a cable is introduced through the section of main to be cleaned. This cable is attached to a single drum hoist mounted on a truck. At the other end a similar truck is employed so that the cable can be pulled back and forth alternately, each truck having a cable of sufficient length to pass through the section of main being lined.

The Scrapers

The cleaning equipment consists of cutting scrapers. These scrapers consist of a heavy wrought steel frame work upon which are mounted cutter blades, the complete equipment consisting of two sections, the cutting blades in the two sections being staggered or rotated so that the trailing section cutter blades cover that part of the pipe wall not scraped by the leading blades. These blades are made up of heavy cast-steel sections mounted on a spider and held ou to position by flat elliptical springs. Each section has three cutting blades for 4″ pipe, and six cutting blades for 6″ and 8″ pipe. All cutting blades have six cutting edges, or knives. Blades are spaced symmetrically around the

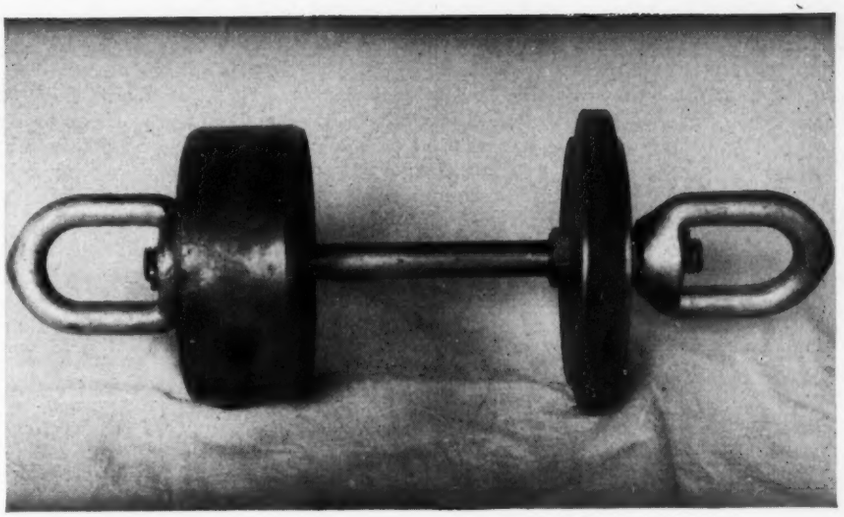
circumference of the spider and the knives are arranged in increasing diameter so that there is in effect a series of cuts made on the incrustations or tubercles on the walls of the main. The knives of the cutters are designed so as to be self-sharpening. The cuttings fall down through the spaces between the blades and with little exception most of this material is left in the main for subsequent removal. These scrapers are passed back and forth two or three times through the main being cleaned, depending upon the amount of incrustation or tubercles to be cut from the walls of the main.

Scrapers are of rugged construction and can readily remove any obstruction in the main such as overrun lead joints or protruding unchartered corporation stops, should such exist. (It might be well to note here that it is very important to have all corporation stops and services removed from the main in advance of the final lining operation, for if not they may cause the cement-lining to fall and form an obstruction in the main.)

Cleaning Brushes and Squeegees

After all adhering tubercles and foreign substance has been cut from the walls of the main, there is then passed through the main a series of scraper brushes made up similar to the scraper section except that the knives are replaced by sections of steel brushes. These steel brushes, built like heavy steel brushes used for cleaning steel plate for painting, are held in a similar manner as the cutter section described above.

Attached to the trailing end of the wire brushes are rubber squeegeeing pistons which are made up of steel plates with rubber discs inserted between the plates. These squeegeeing sections have a double function; first, they trail the wire brushes and force out ahead of them all of the material that has been cut loose by the scrapers and the wire brushes, so that the main is thoroughly cleaned of all loose foreign material. In like manner these brushes and rubber squeegeeing pistons are passed through the section three or more times, after which the brushes are removed, and the squeegees alone are passed through the main. This second operation is to remove all moisture, water, etc., that is lying in the main at low points, as the main must be entirely dry and free of all water. In our experience we found that after passing these squeegeeing pistons through the main, on the final exit the rubber was warm to the hand.



Metal Proving Plug Gives O. K. to Cleaning Job

After this latter operation is completed, all corporation openings, crosses, tees, and outlets must be plugged with plugs that do not protrude into or through the walls of the main, but effectively close the opening. For fittings such as tees and crosses special plugs made slightly smaller in diameter than the bore of the pipe are inserted in the horn or the tee or cross and held in position by clamps. These plugs are made smaller in diameter than the bore of the pipe so that the lining mortar may be forced out around the plug and line the horn of the outlet. After squeegeeing the main for moisture, and before lining, the proper practice is to draw a proving plug through the main to make certain that there are no obstructions that will interfere with or injure the lining machine when it is put through. This proving plug is made of metal or wood that is slightly larger in diameter than the lining machine. It is probably more desirable to pass proving plug by using man power as the operator can thereby obtain a more sensitive survey of the condition of the main. The proving plug, having passed through satisfactorily, the main is now ready to be lined.

Mortar Preparation

Toward the end of the squeegeeing operation, a second gang of men is set to mixing the mortar for the lining. This mortar is composed of one cement and two sand, and is mixed in a steel mixing pan by hand, the procedure being, as in mixing any other mortar, first, to spread the sand out in an even layer over the bottom of the pan, to which is then added the proper quantity of cement, and then with square-nose shovels or billies the sand and cement are thoroughly mixed until an even color is obtained, after which the requisite quantity of water is added to give a satisfactory slump test.

It is important to have the mortar of proper consistency or slump and the amount of slump depends upon the size of the main being lined and the method used in introducing the mortar into the main. If introducing mechanically, a lower slump can be used than if introducing by hand. The company, organized in America, since its operations in Charleston and later at Falmouth, Mass., has developed a mechanical device for loading the cement-mortar into the main. This mechanical loader or charging device consists of a light, wrought-iron pipe connected to the end of the main and having a combination rubber and metal plunger attached to the cable used in cleaning. The cable is pulled up through the pipe so that the plunger is outside of the charging device; the vertical section pipe is then filled with the mortar, after which the plunger is placed in the pipe and pulled downward by means of the cable and the hoisting machine until the mortar is pulled down into the main. The plunger is then pulled back and a second charge of mortar introduced, and this is repeated until a sufficient quantity of mortar has been introduced to line the section of pipe cleaned. This is the more desirable method of introducing the mortar, for as above stated, you can have a lower slump test and less semi-laitance to be squeezed out of the mortar in the lining operation.

Lining Machine

After a sufficient quantity of mortar has been introduced into the main, the loading device is disconnected and the lining machine is attached to the cable. This lining machine is a conical or bullet shaped device having a hol-

low steel frustum of a cone attached to the down-stream end, all mounted on a steel shaft or spindle. This leading or bullet section of the lining machine has two sets of four heavy elliptical cantilever springs set at 90 degrees to each other, which are slightly larger in diameter than the main being lined. The function of these springs you will readily understand, is to hold the lining machine in the center of the pipe, so as to obtain a concentric lining in the main. The hollow skirt (conical section of the liner) is perforated with a large number of conical openings, bored from the inside, so that any material entering the openings from the outside, such as sand and cement, will free itself and not clog the openings. This is an important feature of the lining machine, as it is this portion that performs the function of dehydrating the cement-mortar, allowing the entrained air, excess water and the semi-laitance to pass through and be deposited gently on the bottom of the new lining. The last 1½″ or 2″ of the conical skirt of the lining machine is perfectly plain and smooth, and true to shape, and acts as a trowel to trowel out the mortar that has been plastered against the wall of the main by the pressure of the advancing head of the liner. As implied in the above, the function of the bullet and conical skirt of the lining machine is to force the mortar out against the walls of the main as the machine is being pulled through the main by the cable, the semi-laitance passing through the dehydrating openings and the smooth tail portion of the conical skirt acting as a trowel or float to smooth the interior surface of the mortar. It is important that the spindle upon which the bullet, springs, and perforated skirt-piece of the lining machine are mounted is straight and true in alignment.

There is always introduced into the main for lining a quantity of mortar in excess of that actually required. Some of it goes into the horns of any tees and crosses and fills the open spaces at the bell joints of the main. The average acts as a steadying plunger in front of the lining machine, so that the cable is always under tension and the lining machine under considerable pressure. Mr. Harkness tells me that tests made to determine the pressure immediately in advance of the skirt of the machine show that at times such pressure exceeds 150 pounds per square inch, depending, of course, upon the slump of the mortar, the volume of mortar in advance of the machine, the size and angle of the cone of the lining machine and the grade of main being lined. This, of course, makes for an extremely dense lining.

Over the outlet end of the pipe there is placed a canvas sheet or bag which is tied to the end of the pipe and is held close against the cable used for pulling the lining machine. The purpose of this bag is to create pressure on the excess mortar as it is extruded through the opening in the bag, thus assuring a continuous and uniform lining of mortar on the wall of the main. It can readily be seen that when the job is successfully completed the lined main consists of a continuous smooth bore without joints.

Inspection and Curing

After the main is lined it is important to immediately remove the plugs from the tees and crosses, so that they will not be held in position by the setting mortar. At this time inspection by means of flashlights and mirrors is made of the interior of the pipe, particularly at the larger size openings, such as tees and crosses. Repairs, if needed, can at that time be made to any damage to lining due to the removal of plugs from fittings.

As soon as this inspection is made and everything is found satisfactory, all openings into the pipe, including the entrance and exit ends, should be covered with canvas bags so as to keep the air from circulating through the main, and to obtain the benefit of the heat of crystallization of the cement mortar in setting and the even temperature of the soil, thereby obtaining ideal conditions for curing. Usually within 15 to 20 hours the main can be restored to service, previous to which time the plugs used to close the tap openings at corporation stops may be removed and the section of lining covering these tap openings cut out with either a tool or a knife. In our work at Charleston we used a hand tool made from old combination drills and taps, by sharpening the drill end and inserting a tee handle on the shank end. We found these very efficient and the men could readily drill the cement-mortar out, and at the same time clean the thread in the tapped holes. The corporation stops may then be restored and the inlet and outlet entrances used for lining, closed by inserting a short section of lined pipe, using a solid sleeve. Then the main is filled with water and allowed to cure a further period of from ten to twelve hours. After curing with water for several hours the main is ready to be restored to service by blowing off the curing water through hydrant connections or service line.

For lining bends, off-set pipes, and like fittings, the company has developed a special articulated short type lining machine.

Important Considerations

Important considerations in the process are: First, the thorough cleaning of the main, and as heretofore stated, the removal of all corporation stops and connections to the main being lined. Second, the quality

Force Feed Charging Riser

Note cable and plungers which force into the main the charge of mortar placed in the riser.

of the sand and cement is important, as well as the dehydrating orifices in the skirt of the lining machine.

The preparation in advance of lining and the replacing of line into service, requires about ninety percent of the total time, the actual lining requiring only a few minutes. Usually, depending upon conditions, about 800 feet of main can be lined in a working day of eight or ten hours, but in our work at Charleston, which was experimental, we did not make any such progress. We had distributed the work all over the city in an effort to get a comprehensive picture covering all conditions from ordinary dirt streets with few or no services, to congested residential sections where services averaged one every twenty-five feet, and under modern improved pavement, such as asphalt surface on concrete base.

The quality of the sand and cement used is very important, but of course it is desirable to always, if possible, purchase material that is obtainable locally in the market, and this was the procedure at Charleston. The cement used should have a reasonably long initial setting time. Pennsylvania Dixie Cement Corporation cement, used at Charleston, S. C., had the following characteristics:

Chemical Analysis:

Silica	22.10
Alumina	5.61
Iron Oxide	2.29
Lime	65.12
Magnesia	1.33
Sulphur Trioxide	1.50
Loss on Ignition	1.86
	99.81
Insoluble Residue	0.35

Compounds:

C_4AF	6.97
C_3A	10.97
C_2S	21.16
C_3S	54.62

Physical Properties:

Fineness..93½% through a No. 200 Sieve
Specific Surface..1750 sq. centimeters per gram
Setting time, with Gilmore needle, initial 3 hours; final 5 hours
Tensile Strength: Proportion 1 to 3 Standard Ottawa sand briquettes:
250 lb.— 3 days
340 lb.— 7 days
430 lb.—28 days.
Cement was manufactured in every respect to meet the standard specifications for portland cement A.S.T.M., and Federal Specifications SS-C-191a.

The sand used was a sand obtained locally and known as the Saukehatchie pit, located near Yemassee, South Carolina. The grading test on this showed the following:

Retained	14	mesh	0.49%
"	28	"	10.58%
"	48	"	67.15%
"	100	"	17.58%
Passing	100	"	4.23%

The Important Mortar Slump Test

The sand as received had the normal pit moisture and it was necessary to dry and screen it. On account of not being able to obtain proper screens we used No. 16 mesh galvanized window screening and rejected all material failing to pass this mesh screen. The sand, after drying and screening, was sacked, using one cubic foot to a sack, and hauled from storage bin to the job. The proportions of mortar used in lining were one to two and the slump test averaged from 7½" to 9", depending upon whether hand or mechanical means were used in charging the mortar into the main. The test of the mortar as mixed on one of the jobs is as follows. In this particular case the slump was 10", a little bit in excess of what was normally used for hand charging:

TENSILE STRENGTH—POUNDS PER SQUARE INCH

Time	As placed in the Pipe	Surplus cement mortar as extruded from the main lined
1 Day	175	180
3 Days	317	318
7 Days	417	467
28 Days	580	510

Curing for the first 24 hours in moist air, remainder of the time in water.

In our experimental work, it was our aim to place approximately ¼" thickness of lining in the main, but we were not at all times able to maintain this thickness, as we had a number of sections of pipe—one section of 8" pipe in particular—where we had ⅛" over nominal diameter to as low as ⅛" under nominal diameter, so we necessarily had to line this section with a lining machine not exceeding 7½" in diameter, which gave us a $\frac{3}{16}$" minimum and a $\frac{5}{16}$" maximum lining; but generally we obtained very close to ¼" thickness of lining. This is probably somewhat thicker than necessary, for we believe a $\frac{3}{16}$" lining is just as good and probably as easy to obtain, provided, of course, you have a regular bore in the main to be lined.

The quantity of cement-mortar required to be introduced into the main varied with the diameter and averaged as follows for a section of 350 feet:

4" main	105 feet
6" main	80 feet
8" main	60 feet

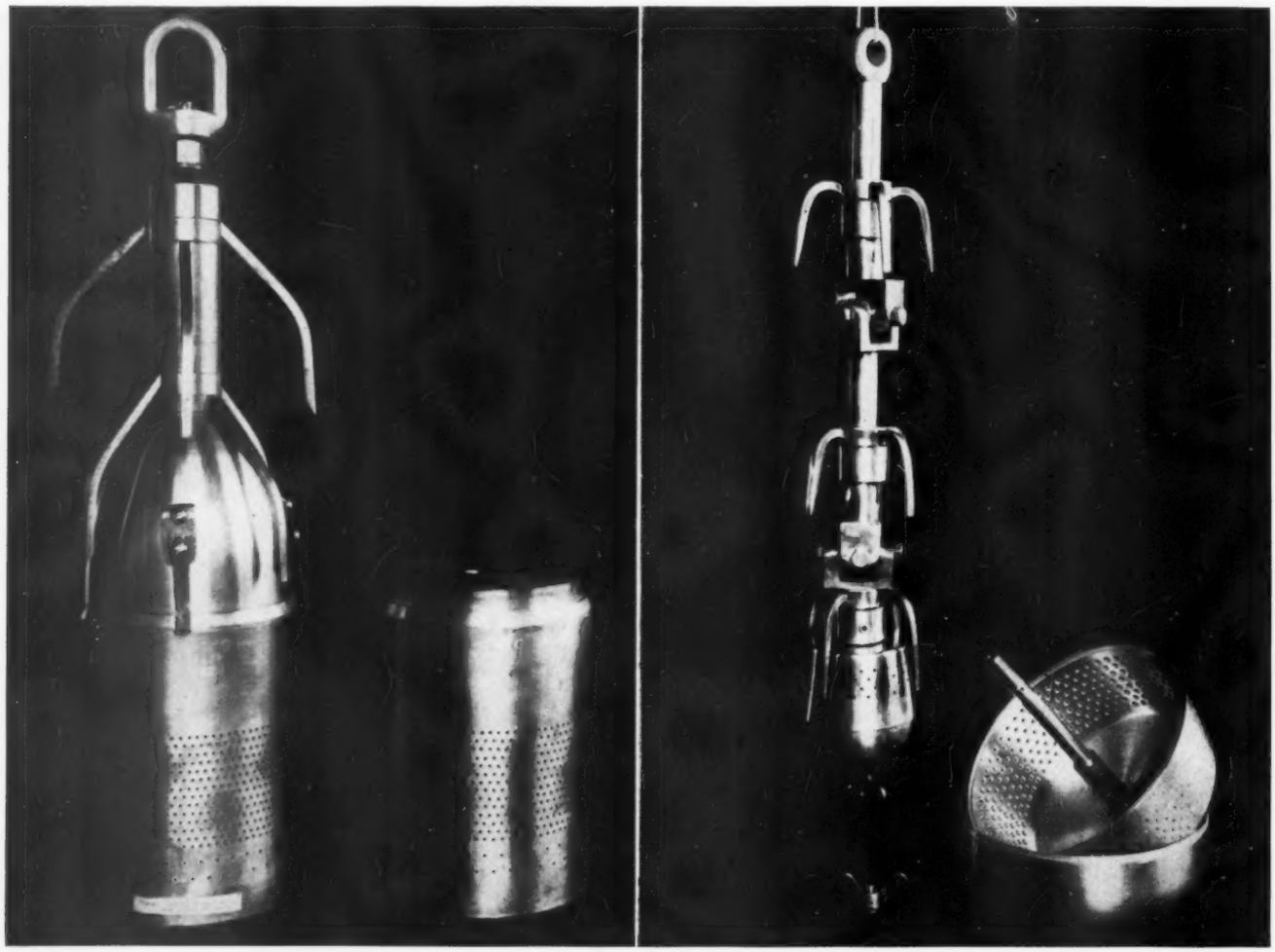
In all cases, this quantity of mortar gave sufficient mortar to line the pipe completely, together with any connecting branches for hydrants, street crosses, and tees, and an ample surplus extruded from the outlet end of the main.

Attainments and Results

Statistical data as to location, diameter, and condition of the mains before cleaning, and after cleaning and lining, appears in an accompanying table. It will be noted that the value of "C" on nominal diameter of pipe, was as low as 33 for a 4" main before lining, to a maximum of 128 on an 8" main after cleaning and lining. Expressed in percent increased carrying capacity, the gains due to lining ran from 210 to 280 percent. The age of pipe varied from twenty years to sixty years. Measurements to de-

TABLE 1
TABULATION OF INFORMATION AND RESULTS
Lining 4-inch, 6-inch, and 8-inch Cast Iron Mains in Place by Tate Linings, Inc., of Andover, Mass.
(Age of Pipe 20 to 60 Years—Total Feet 12.009)

	Nominal Diameter Age of Pipe	Lin. Ft. of Pipe Lined	Lin. Ft. of Pipe Tested	Flow Cu. Ft. per Minute	1000 Gallons per 24 Hrs.	Loss of Head per 1000 Ft. of Pipe	Average Value of "C" Nominal Diameter Hazens & Williams Formula	Percent of Improvement
Durant Avenue, North Charleston:	8"							
Before Lining	.....	3450.50	358	32.47	350	7.1	53	
After Lining	27 yrs.		358	32.63	351	1.77	112	210
Charlotte Street, Washington to Concord:	8"							
Before Lining	.....	652.70	257	43.26	466	12.9	51	
After Lining	29 yrs.		257	41.28	445	2.125	128	251
Prioleau Street, Tradd to S. C. Wacht Club:	6"							
Before Lining	.....	688.00	244.7	40.52	436	81.4	39	
After Lining	60 yrs.		303.0	36.40	392	12.0	98	251
Legare Street, Tradd to South Battery:	6"							
Before Lining	.....	1255.00	271.0	34.17	368	37.35	50	
After Lining	60 yrs.		271.0	35.18	379	8.33	117	234
King Street, Broad to South Battery:	6"							
Before Lining	.....	2029.10	328.0	34.1	368	46.3	44	
After Lining	60 yrs.		328.0	36.33	392	9.45	113	257
East Bay Street, Broad to Tradd:	8"							
Before Lining	.....	600.00	351.0	38.78	417	17.5	40	
After Lining	60 yrs.		296.0	39.45	425	2.51	112	280
East Bay Street, Tradd to Water:	6"							
Before Lining (No Test)	.....	789.4	.....	.....	.....	.....	.....	
After Lining	60 yrs.		206	38.33	418	10.31	113	.....
East Bay Street, Water to Atlantic:	6"							
Before Lining (No Test)	.....	195.6	.....	.....	.....	.....	.....	
After Lining	60 yrs.		172	33.6	362	10.85	95	.....
Hackemann Avenue, Meeting to Fourth Street:	4"							
Before Lining	.....	1143.54	300	10.77	116	67.9	33	
After Lining	20 yrs.		300	26.64	287	69.7	81	245
Hampton Avenue, Meeting to Fourth Street:	4"							
Before Lining	.....	1205.32	286	12.15	130.7	67.3	37	
After Lining	20 yrs.		286	29.37	316.4	66.8	88	238



Tate Lining Machines
(Left) Machine for straight-away pipe lining. (Right) Articulated machine for bends or crooked lines

termine the value of "C" were based upon the actual measurement of water through a velocity type of meter, the piezometric head being measured with mercury or acetylene tetrabromide fluid in the U tube. The length of pipe involved in the tests varied from 172 feet to a maximum of 358 feet. All of these values are based on the nominal diameter of the pipe, since we were not particularly interested in the academic question of such values based on the actual diameter of the cement-lined main. However, in one case we did measure the diameter of the main after cleaning and determined the value of "C," which in this particular case was 140. This was a 4" pipe with actual inside diameter of 3.36", after lining, the reduction in area being 29.6%. The actual discharge through the 4" main before lining was 130,700 gallons per 24 hours with a loss of head of 67.3 feet per 1000 feet of pipe. After cleaning and lining, with a loss of head of 66.8 feet per 1000 feet, the delivery per 24 hours was 316,400 gallons, or an increase in the delivery capacity of 240%.

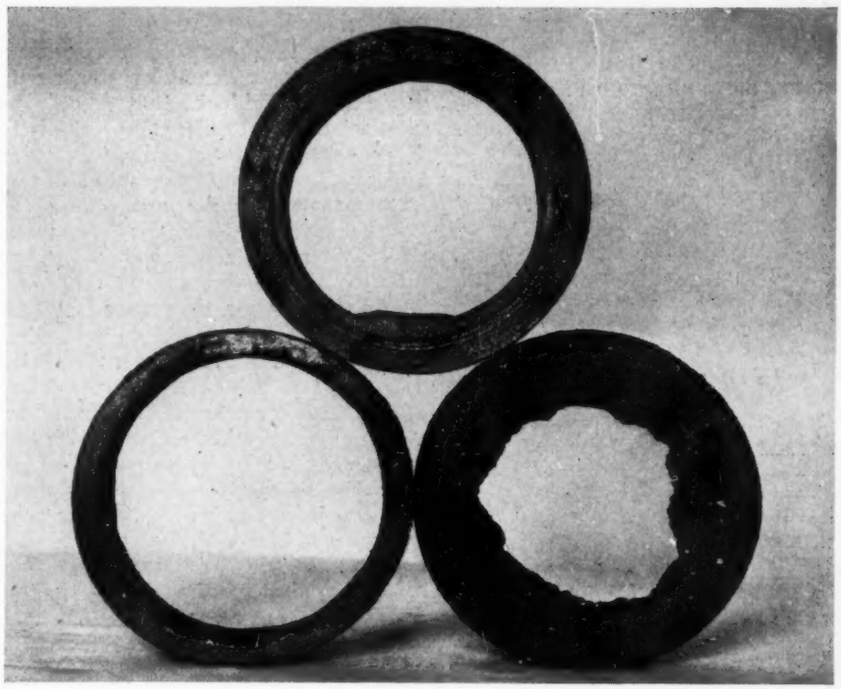
With the use of the hand charging and a high slump (9" to 10"), there is considerable semi-laitance material squeezed through the dehydrating orifices so that there is a flat segment left in the bottom of the pipe. This material is of about the same nature as the mortar used in lining the pipe, but nevertheless this segmental area is objectionable to the extent that it does reduce the area of the pipe, and the desirable condition would be to reduce it to the irreducible minimum. To accomplish this, it is desirable to use as low a slump test as possible, and this requires the use of a mechanical charging device.

Costs

The cost of the work ran from about ¼ to ½ the cost of replacement of the main, and of course varied with the kind of paving, number of services, hydrant and street crossing connections. It can be readily seen that the cost of cleaning and lining 8" main is is relatively much cheaper per foot than the 4" or 6" main as the cost of opening up the paving in the street for introducing the cleaning scrapers, cement-mortar and lining machine, service, hydrant, and street crossing connections, is practically the same without regard to the size of the main lined. The time of cleaning and lining is relatively the same, and therefore the only increased cost in lining 8" main over 4" and 6" main, is the cost of the material required and the cost of the larger equipment. Actually in our trial projects at Charleston, based upon the condition under which the work was done, the cost of the work was as follows:

	Per Ft.
4" main:	
Sand asphalt penetration pavement, with taps averaging one about every 60 feet	$0.55
Unpaved street, with few services, little traffic, this cost dropped to	.45
6" main:	
Paved territory, asphalt concrete base, services averaging every 30 feet apart	.90
Open territory, unpaved streets	.46
8" main:	
Paved street, asphalt concrete base, with services averaging every 60 feet	1.55
Unpaved streets, minimum number of services	.50

These costs included the cost of opening up the street and replacing the paving in every case, and in residential sections where there were numerous services, the installation of a 2" galvanized main at the curb, with connections to receive water at each end, and the connection of the service pipes to this temporary main. It does not include any cost for the material used in making these temporary connections, and the figures given in this tabulation are averaged for the work. The maximum, at times, went to probably 50% above these averages. This, however, was an exceptional case where the main was sixty years old, and was very much deteriorated due to the soil corrosion; and the further fact that it was a very thin cross-section, walls being less than ⅜" thick in places. The average depth of the main was 36-inches cover.



Sections of 6-Inch Main Before and After
Note the lined section at the top, showing the bottom segment of semi-laitance which should be kept to a minimum.

Conclusions

Attainments from our trial projects in Charleston have been very satisfactory indeed, and we have no hesitancy in saying that we will do additional lining as soon as we can, and financial conditions allow it. We have received very complimentary remarks from the consumers along the lines which we have lined in that the volume of the water has been increased and they do not suffer from the periodic disturbances and roily water as formerly when excessive drafts occurred.

Some Pertinent Considerations

To reduce the segment of material passing through the dehydrating orifices of the lining machine it is desirable to maintain as low a mortar slump test as possible. To that extent we feel that the introduction of some plastercizing material such as Celite, Duracrete, or even hydrated lime, would be desirable in that it would give a more plastic and buttery mass than the straight Portland cement and sand. The introduction of this inert material would probably slightly reduce the strength of the mortar on a tensile test but as we see the picture this is immaterial as long as the mortar has sufficient strength, cohesion, and stability to adhere and maintain the arch in the main. Our experiments show that by the use of such plastercizing material a very much reduced slump test can be had.

Use of Graded or Kiln-Dried Sand

To obtain the best results, we believe it would be advisable to pay considerably more attention to the grading of the sand, even to the extent of having it kiln-dried and graded. Since completing the Charleston work, this was demonstrated conclusively, I think, in the work done by Tate Pipe Linings, Inc., at Falmouth, Mass. In that project, kiln dried and graded sand, put up by the material contractor in cubic-foot sacks, was used. Analysis of that sand, as furnished by the Tate people, is as follows:

Mesh	*Percentage Retained*
10	0.5
20	10
30	35
40	16
50	26
80	5
100	7
200	0.5

The advantages of using kiln dried and graded sand are that you can better control cement-water ratio and obtain the grade of aggregate that you desire; and, since the sand cost is such a small percentage of the total cost, the additional expense of kiln drying and grading is not of moment.

Necessity of Lining

A survey[4] of water supply facilities of the United States, 1939, shows that there are 12,760 water works plants in the United States, serving 13,293 communities. Of the total number of water supply systems, 8483 obtain water from either driven, bored, or shallow dug wells, springs or infiltration galleries; and 3123 from surface supplies such as streams and lakes. There are 2188 systems having filter plants.

It has been recognized for a number of years that the process of treating and filtering water disturbs the chemical balance of the water, making it more aggressive. Filtration engineers and chemists have corrected this to a great extent by treatment, but there is evidence that tuberculation is not always completely checked by such treatment. Estimate of the mileage of mains, based upon the 1930 census and the known mileage of mains in some fifty-three cities and urban communities, brought up to July, 1939, indicates that there are in continental United States not less than 224,000 miles of cast-iron water mains 4″ and above in size. We estimate that at least 90%, or 200,000 miles, are from 4″ to 12″ in diameter, so it can readily be seen that with the known active or aggressive waters throughout the country there is a large field and necessity for the restoration of carrying capacity of the mains now laid and in service. The reconditioning of these water mains in place means that their functional life will be increased from a few years to probably as many as fifty years, depending upon their present age. The process should effect a considerable economic saving to water companies and municipalities throughout the United States.

Permanency of Lining

There has been considerable discussion among engineers and chemists as to the permanency of cement-mortar lining, particularly due to the leaching or dissolving out of the calcium content of the cement, destroying the stability of the mortar. Time, which is the test of all material things, indicates that this deterioration is much like Mark Twain's death "very greatly exaggerated," for we have records of cement-mortar lined water mains and service pipe laid in New England, sixty years of age or older, that are still in service and going strong.

Size of Mains That Can Be Tate Lined

Representatives of the Tate people tell me that the largest main that they have yet lined in the shop is 15″; and I can see no reason why in-place lining cannot be carried out successfully up to 12″ diameter pipe. The difficulty of lining larger mains by the Tate Process, as we see it, is maintaining a satisfactory plug or volume of cement mortar to fill the cross-section of the main in advance of the lining machine. We understand, now, that a type of dam or baffel has been devised to maintain the desired mortar plug under compression ahead of the lining machine.

There are, so far as we are aware, only two companies attempting to recondition or line mains in position. They are the Tate Pipe Linings, Inc., of Andover, Mass., for mains from 6″ to 12″ in diameter, and the Centriline Corp. of New York, a new company that has just recently been organized by T. A. Gillespie, the Lock Joint Pipe Co. and the Raymond Concrete Pile Co., who have taken over the patents of the Perkins Process for lining steel and cast-iron mains of large diameter with cement-mortar. This work has formerly been done by the T. A. Gillespie Co.

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2. Proceedings of the American Water Works Association, Vol. 27, No. 8, Page 1073, August, 1935. "Applying Cement Mortar Lining to Existing Mains in England."

3. Proceedings of the New England Water Works Association, Vol. 53, No. 3, Page 284, September, 1939. "Cleaning and Lining Existing Pipe Lines in Buenos Aires."

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Cast Iron Liner Plates Used in Sewer Rehabilitation

A New Orleans pressure sewer after 30 years of service began to leak due to bottom wear caused by grit scour. An estimate of replacement cost ran to $700,000, so it was decided to attempt repairs by an ingenious scheme developed experimentally by engineers of the New Orleans Sewerage and Water Board.

The method developed involved the use of curved plates of cast iron, which are fastened to the inside bottom of the conduit with pure wrought iron pins. By this method the sewer was successfully repaired with a crew of six men and a foreman, at a total cost of only $50,000 as against the estimated expenditure of $700,000 which replacement would have necessitated.

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THE USE OF "BENOCLOR-3" IN POTABLE WATER SUPPLIES

An Investigation of the Effects of this Weed Killing Chemical on Tastes and Odors

The Author

By MORTIMER M. GIBBONS
Sanitary Chemist
NEWARK, NEW JERSEY

IN the densely populated Eastern section of the United States, many of the natural lakes and ponds are within the watershed of some municipality. In recent years, there has been a distinct trend toward an increasing recreational use of potable watersheds.

For recreational purposes, alone, it is frequently desirable to control dense growth of aquatic weeds in order that boating and bathing may be enjoyed. And, in potable water supplies decaying vegetation and anaerobic decomposition is frequently the source of foul odors and/or tastes in varying degrees.

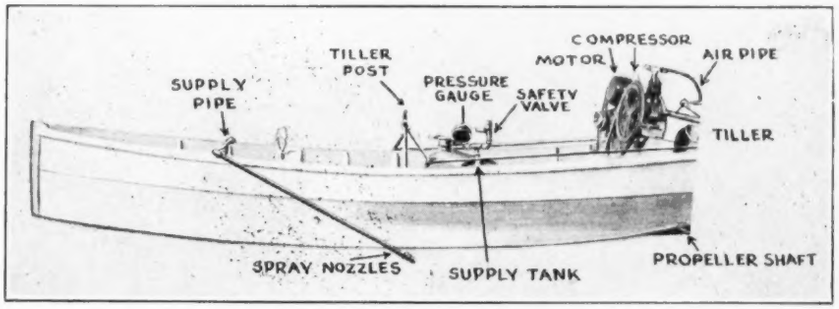
Under certain circumstances, the oxygen used by live vegetation during darkness or murky days may be sufficient, in combination with the oxygen demand of dead vegetation, to abstract most of the dissolved oxygen from the water. Occasionally, fish have been killed in water bodies as a result of such phenomena. Consequently, the control of rooted marginal vegetation may reduce the seasonal accumulation of decaying organic matter and thus indirectly contribute to improved water quality. However, water supply engineers are necessarily cautious concerning the control of vegetation by herbicides, because such chemical agents may in themselves impart an odor or taste to the water.

Chlorinated Compounds for Weed Control

The use of chlorinated organic compounds for controlling algal and slime growths has been one of the recent developments in industrial water treatment. Many of these compounds cannot be used in potable water supplies because they are both odorous and completely water soluble. An investigation of the effect of one of the most promising of these compounds—"Benoclor 3," offered for use in aquatic weed control—(see W. W. & S., July, 1938, p. 688) upon the odor of water in a potable water supply, was made in cooperation with the manufacturers of this product during the past summer.

Field Tests on Large Scale

Echo Lake, situated in Westfield, N. J., was selected for the field tests. This body of water lies within a public park and is used for recreational purposes. Ducks and swans are maintained there. Fishing and boating is permitted. The lake is divided into two sections. The Upper Lake has nine million gallons capacity and the Lower Lake, of fifteen million gallons and fed from the Upper Lake, discharges in part through Rifle Range Pond, of four million gallons



Outboard Motor Boat Equipped for Applying "Benoclor 3"

The speed set for the boat determines the dosage per acre, since the rate of chemical discharged through the nozzles is held constant under fairly constant air pressure maintained in the supply tank.

"Benoclor 3" is a liquid chlorinated benzene. It has a pungent odor, but is almost insoluble in water. One of its most pronounced characteristics is its heavy weight, having a specific gravity of 1.45. It is applied under water by mechanical dispersion, using atomizing nozzles under pressure from a tank in a boat. (See cut.) The chemical leaves the nozzle in fine droplets which settle through the water, and eventually adhere to vegetation or the bottom material. Apparently, the roots are attacked and the rooted weeds or plants are killed in a few days and seem to drop to the bottom, where slow disintegration takes place.

capacity, before joining the Rahway River. Another part flows direct to the river. The municipal water supply of Rahway, N. J., is taken from the Rahway River about eight miles below Lower Lake. During dry weather, flows from Echo Lake represent about 20% of the flow of the Rahway River reaching the Rahway Filter Plant. (See accompanying sketch.)

First Application of "Benoclor 3"

The first application of "Benoclor 3" was made in the Upper Lake only. Thirty-five (35) gallons of the herbicide were dispersed in a portion of the lake at the rate of 12 gal. per acre

TABLE I
Summary of Odor Measurements

Sampling Station	*First Application Benoclor*				*Second Application Benoclor*							
	After 3 Days		After 46 Days		After 1 Day		After 5 Days		After 12 Days		After 33 Days	
	T. O. No.	Flow M.g.d.	T. O. No.	Flow M.g.d.	T. O. No.	Flow M.g.d.	T. O. No.	Flow M.g.d.	T. O. No.	Flow M.g.d.	T. O. No.	Flow M.g.d.
1	15 veg.		20 veg.		15 veg.		25 veg.		25 veg.		12 veg. mus.	
2	150 med.		20 veg. mus.		80 arom. chem.		60 arom. chem.		30 arom. veg.		15 veg. mus.	
3	150 med.		20 veg. mus.		50 arom. chem.		60 arom. chem.		30 arom.		20 veg. mus.	
4	50 med.	1.7		1.7	50 arom. chem.	1.4	40 arom. chem.	1.9	40 arom.	1.8	15 veg. mus.	1.7
5					20 veg.	3.1	30 arom. chem.	2.7	25 veg. mus.	5.1	12 veg. mus.	2.4
6					15 veg.		25 veg.		25 veg. mus.		15 veg. mus.	
7					15 veg.		20 veg. mus.		30 mus.		15 mus.	
8					15 veg.	7.0	25 veg. mus.		30 mus.	21.4	15 mus.	5.5
9					20 veg. mus.		20 veg. mus.		30 mus.		15 mus.	
10	20 veg.	9.5	22 veg.	6.9	20 veg. mus.	8.1	20 veg. mus.	7.5	25 mus.	24.7	15 mus.	7.7

Notes: T. O. No.—Hot threshold odor number (65°C.)
First Application Benoclor 3—May 26, 1939.
Second Application Benoclor 3—August 9, 1939.

on two successive days. Water samples were collected from Sampling Stations 1, 2, 3, 4, and 10, indicated on the map, three days after the first application. This permitted time for diffusion of the chemical from the vegetation and bottom mud into the water above; and it was well under the nominal flow time to the filter plant intake, as indicated in the accompanying flow schedule. Water samples were collected at the filter plant daily thereafter for several weeks.

Sampling Station		Distance from Inlet	Nominal Flow Time from Station 3
1	Inlet	0	
2	Treated Area	0.1 mile	
3	Outlet-Upper Lake	0.2 "	
4	Outlet-Lower Lake	0.8	9 days
10	Water Works Intake	8.5	13 "

The effect of dispersion or unequal displacement of the water in flowing through the several shallow ponds in its course was compensated by approximately simultaneous sampling along the eight-mile course at this early stage, and also by the daily sampling at the plant thereafter. The dispersion factor was of considerable importance as may be noted in Table I from the appearance of odor in the water at Station 4 after 3 days, although the nominal detention period, based on calculations, was 9 days.

A second set of water samples was collected from the treated area, proper, about six weeks after the application of the chemical. This was done to determine the delayed effect, if any, of the previous treatment upon the quality of the water.

Test Procedure

A sanitary analysis of all water samples was made and the hot threshold odor number was also determined. [Although a great many complete sanitary analyses were made only a limited number need be reproduced with this paper, since they are rather space consuming.]

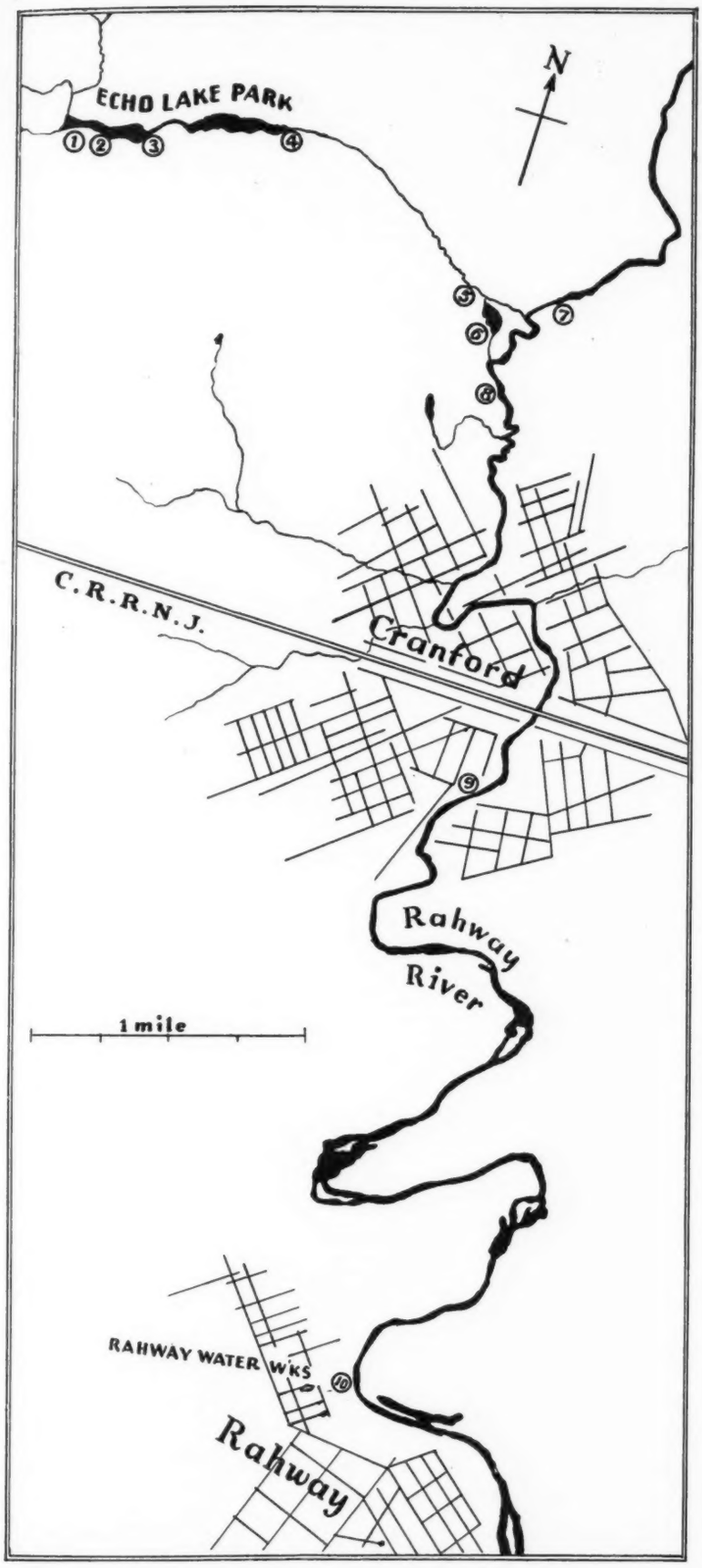
In making the hot odor test the following procedure was employed.

A portion of the water sample was transferred with a pipette into a 500 cc. glass stoppered, odor free Erlenmayer flask. Odor free water at 65°C. was then added to the flask in amount sufficient to give a total volume of 250 cc. of liquid. The contents of the flask were thoroughly shaken, the pressure within the flask being momentarily equalized with atmospheric. The flask was then placed in a water bath, to maintain a constant temperature of 65°C., for 15 minutes. It was then smelled, sniffing the vapors once through a cavity type nosepiece. Two observers smelled the flasks independently. The greatest dilution of the sample, in which odor could be detected, was recorded as the threshold dilution. The threshold odor number is the ratio of total (diluted) volume to volume of sample therein.

Results of the First Application

The results of the first application are summarized by the data in Table I, and Diagram A. The immediate effect of the treatment was a ten-fold increase in the hot odor concentration of the water in the treated area. The quality of the odor changed from vegetable in the inlet water to a medicinal odor in the treated water. As the water passed slowly out of the treated Upper Lake into the untreated Lower Lake, the odor concentration was reduced by the dilution. At Station 4, the outlet of Lower Lake, the water had a hot threshold odor number of 50 medicinal. Below this point, there were available nearly five volumes of additional river water for each volume of contributory flow from Echo Lake. The water at the filter-plant intake during this period maintained a normal hot odor concentration of 20-25 vegetable. The hot odor concentration usually is about ten times greater than the cold odor concentration in the Rahway River water at the plant. No trace of medicinal odor was detected at this point. It was evident that between the Echo Lake overflow and the filter-plant the chemical constituent of the odor had been masked or dissipated by factors other than dilution, possibly absorption by organic matter, aeration or evaporation from storage ponds. The need for additional sampling stations along the water course was apparent.

Samples of water collected within the treated area about six weeks after



Lakes and River Course Showing Sampling Stations by Numbers.

treatment, showed no residual effect of the Benoclor 3.

Second Application of "Benoclor 3"

The preliminary field test showed the desirability of further data on the change in water quality between the treated lake and the Rahway Filter Plant. Accordingly, several additional sampling stations were located along the water course, as indicated on the accompanying sketch.

Sampling Station		*Distance*	
1	Inlet	0	
2	Treated Area	0.1	mile
3	Outlet Upper Lake	0.2	"
4	Outlet Lower Lake	0.8	" *
5	Nomahegan Brook	1.8	"
6	Outlet Rifle Range Pond	1.9	"
7	River Above Junction	1.9	"
8	River Below Junction	2.0	"
9	Half Way to W. W.	4.2	"
10	W. W. Intake	8.5	" *

*Normal time of flow Sta. 4 to Sta. 10 is 4 days.

The exigencies of the situation demanded that both the Upper and Lower Lakes be treated for weed control. Fifteen (15) gallons of the herbicide were dispersed in a portion of each lake at the rate of 12 gal. per acre on August 9th. Water samples were collected approximately simultaneously from ten sampling stations at intervals of 1, 5, 12, and 33 days after the Benoclor treatment. The samples were tested in the laboratory, as previously described.

Results of the Second Application

The water samples of August 10th, 1 day after dosing, showed an immediate rise of odor concentration of 3 to 5 fold at Stations 2, 3, 4 within the treated area—(see Table I). The quality of the odor changed from vegetable in the inlet to aromatic chemical at the above stations. All the samples from stations below (4) had a normal odor concentration and quality, as revealed in Tables I, IV and in Diagram A.

The water samples of August 14th, (5 days after dosing), retained the aromatic chemical odor at stations within the treated area (2, 3, 4), although reduced in concentration. The water from Station 5 (1 mile below 4), had an aromatic vegetable odor. The odor of the sample from Station 6, the outlet of Rifle Range Pond was entirely vegetable, indicating absorption of the aromatic constituent by the algal growth there —(see Table I, Second Application).

The water samples of August 21st, 12 days after dosing, retained an aromatic odor at stations within the treated area. This odor was somewhat

TABLE II

Odor of River Water at Water Works Intake*

[Following Second Application Benoclor]

Date	Threshold No. Hot	65°C.	Flow m.g.d.
Aug.			
10	20	veg. musty	8.1
11	20	veg. musty	7.1
12	20	veg.	6.7
13	20	veg.	6.7
14	20	veg. musty	7.5
15	20	veg. musty	7.0
16	20	veg. musty	7.1
17	20	veg. musty	6.2
18	20	veg. musty	6.1
19	20	veg. musty	6.0
20	25	musty	83.8
21	25	musty	24.7
22	20	musty	13.1
23	20	musty	8.9
24	20	musty	6.8
25	20	musty	7.1

*Sample Sta. 10—See map.

changed in quality from the previous aromatic chemical odor and reduced in concentration. All the remaining samples were of normal odor—(see Tables I and VI).

The final set of water samples was collected on September 11th, 33 days after dosing. The odor of the water in these samples was free from any detectable trace of the Benoclor treatment—(see Table I).

The sanitary analysis of the four sets of water samples indicated considerable algal growth, occurring in the shallow ponds—(see Tables IV and VI) Nitrate reduction took place in the ponds. However, no significant change in the sanitary quality of the water, except temporary increase in odor, could be ascribed to the herbicide.

The raw water quality at the Water Works Intake (Station 10) during the period of August 10-25th showed no detectable effect of the application of the herbicide upstream. The water was purified by the usual procedure, viz.: alum coagulation, activated carbon, sand filtration and ammonia-chlorine treatment of the filtered water. The results were entirely normal.

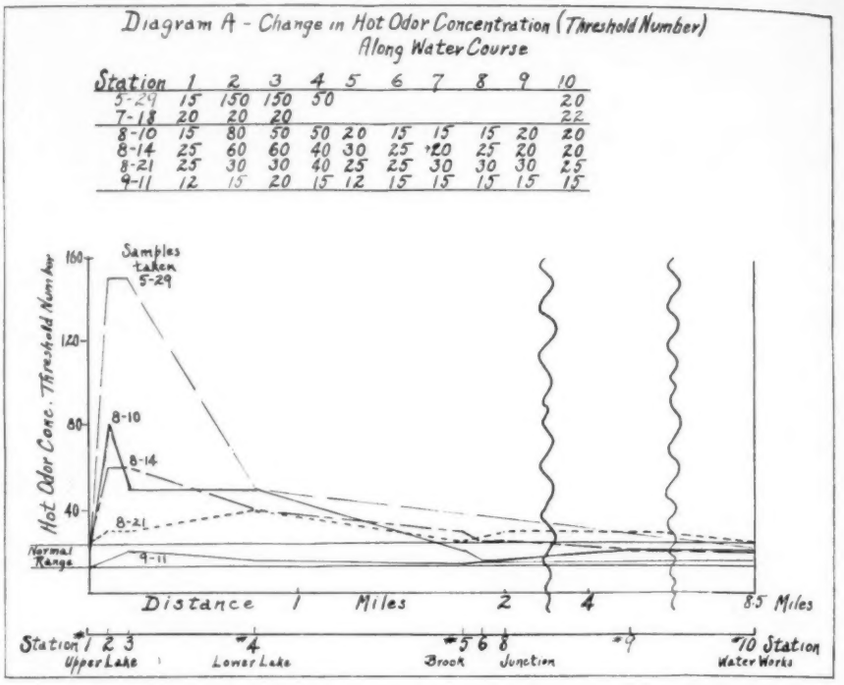


Diagram A - Change in Hot Odor Concentration (Threshold Number) Along Water Course
Station 1 2 3 4 5 6 7 8 9 10
5-29 15 150 150 50 20
7-18 20 20 20 22
8-10 15 80 50 50 20 15 15 15 20 20
8-14 25 60 60 40 30 25 20 25 20 20
8-21 25 30 30 40 25 25 30 30 30 25
9-11 12 15 20 15 12 15 15 15 15 15
Samples taken 5-29
Hot Odor Conc. Threshold Number
160
120
80
40
8-10
8-14
8-21
Normal Range
9-11
Distance 1 Miles 2 4 8.5 Miles
Station 1 2 3 4 5 6 8 9 10 Station
Upper Lake
Lower Lake
Brook
Junction
Water Works

Graphical Record in Study of Odor Changes Down 8.5 Miles of Stream.

From an analysis of the data obtained after the second application, it is again evident that the water displaced from the dosed lakes lost the acquired aromatic chemical odor. It was further evident that the dilution available was not sufficient to account for this. For ten days following treatment dry weather flow conditions prevailed, during which there were available below Station 4 from four to six volumes of untreated water for each volume of contributory flow from Echo Lake. The results of August 14th at Stations 5 and 6 indicated absorption of the characteristic aromatic odor by algal growth or possibly by evaporation to some extent. Between Stations 4 and 5, turbulent flow conditions with resulting aeration prevail in the upper section of the brook.

Effects on the acquired odor by outdoor storage and aeration was next investigated.

Effect of Outdoor Storage and Aeration

River water was dosed with Benoclor 3 at rates of 12 gal./acre and 24 gal./acre, respectively. The raw water was placed in open ceramic crocks and then the herbicide was injected under water from a hypodermic needle. The crocks were stirred thoroughly with a wooden paddle for five minutes and then allowed to settle quiescently for two days. After two days, a portion of the water from the middle of the crocks was siphoned off and exposed to the atmosphere. Portions of the raw water, of the 12 gal./acre, and of the 24 gal./acre dosed waters, were placed in 2 liter beakers, filled within

TABLE IV*

Sanitary Analysis of Water Samples of Aug. 10, 1939
(One Day After Second Treatment)
(Parts per Million)

Sample No.	Water Temp.	Turb.	Color	p.H.	Alkalinity Phenol	Alkalinity M.O.	Soap Hardness	Oxygen Consumed	Free NH_3	Nitrogen-N Nitrite	Nitrogen-N Nitrite	Cold Odor
1	72	3	18	7.5	0	77	102	3.2	0.70	0.040	0.36	veg.
2	79	2	22	8.2	6	73	95	4.1	0.40	0.030	0.09	arom.
3	81	5	27	8.4	10	72	99	4.6	0.20	0.026	none	arom.
4	76	4	35	7.2	0	76	100	4.9	0.30	0.012	none	veg. arom.
5	71	4	25	7.4	0	74	104	4.0	0.20	0.030	0.23	veg.
6	77	9	33	8.1	.7	72	95	4.9	0.20	0.004	none	veg.
7	71	3	25	7.4	0	79	97	3.7	0.15	0.034	0.41	veg.
8	73	4	25	7.5	0	79	106	4.5	0.15	0.026	0.32	veg.
9	75	9	30	7.4	0	78	111	4.7	0.15	0.036	0.32	veg. musty
10	73	10	37	7.3	0	65	101	5.2	0.15	0.012	0.09	veg. musty

* Tables III, V, VII, and IX have been deleted, since those being reproduced are typical.

TABLE VI*

Sanitary Analysis of Water Samples of Aug. 21, 1939
(12 Days After Second Treatment)
(Parts per Million)

Sample No.	Water Temp.	Turb.	Color	p.H.	Alkalinity Phenol	Alkalinity M.O.	Soap Hardness	Oxygen Consumed	Free NH_3	Nitrogen-N Nitrite	Nitrogen-N Nitrite	Cold Odor
1	74	11	42	7.5	0	66	90	4.4	0.06	0.020	0.13	veg.
2	79	12	44	7.8	2	69	84	4.8	.06	.028	.04	veg.
3	79	12	55	7.9	3	73	92	5.4	.08	.024	.04	veg. arom.
4	76	6	43	7.3	0	75	85	4.5	.20	.016	none	veg. arom.
5	74	4	55	6.8	0	55	100	9.0	.12	.016	.07	veg.
6	81	10	65	6.8	0	31	65	7.9	.12	.012	.07	veg. mus.
7	75	5	55	6.9	0	45	68	7.2	.20	.024	.25	musty
8	75	10	65	6.9	0	44	74	8.0	.20	.020	.27	musty
9	77	12	65	6.7	0	32	58	8.4	.20	.016	.22	musty
10	76	15	60	7.1	0	33	54	6.3	.12	.012	.13	musty

* Tables III, V, VII, and IX have been deleted, since those being reproduced are typical.

½ in. of the rim, and stored outdoors on a window ledge for several days. The samples were thus exposed to atmospheric dust contamination. Each sample was tested for hot odor daily, as shown in Table VIII and Diagram B until the characteristic aromatic chemical odor disappeared. Water and air temperatures were recorded twice daily. The ground wind was estimated from records of the nearest Weather Bureau. A sanitary analysis of each sample was made at the start and finish of the storage period.

The acquired odor was greatly reduced in concentration after 5 days of exposure, and was not detected after 8 days. The time required can be expected to vary under different meteorological conditions and with different sized and shaped water bodies. The rate of evaporation from small containers such as were used would be considerably faster than from large natural ponds. In Diagram B, the odor concentration is plotted against period of storage. There was an initial period of unchanged concentration for 2 to 3 days, followed by a sharp drop in concentration after 4 to 5 days. A rather interesting observation is the increased rapidity of odor disappearance at the higher dosage, both reaching about the same point after 6 days. No close correlation could be observed between the rate of change in odor concentration and the change in those meteorological factors which influence the evaporation of water, viz.: temperature difference, vapor pressure difference and wind action. However, the sharp decrease in odor appeared to coincide with an increase in water temperature. It seems probable that the low heat of vaporization of chlorinated benzene products, in comparison with that of water, favored the more rapid evaporation of the dissolved herbicide.

The effect of aeration upon the reduction of odor concentration of the treated samples was determined by bubbling air through the odorous water. About 3000 cc. of air were passed through a 500 cc. sample in 30 minutes. The hot odor of each sample was tested before and after aeration. The results were as follows:

Threshold Odor Number at 65°C.

Before Aeration	After Aeration
100 arom. chem.	10 arom. chem.
150 " "	25 " "

The beneficial effect of the aeration is apparent. The available aeration in water supply systems, of course, varies widely.

The sanitary analysis of the treated and untreated water samples stored outdoors, indicated a rather pronounced increase in the oxygen consumed value of the untreated samples, 3.8 p.p.m. rising to 13.4 p.p.m. during the 10 days, as compared to 4.5 and 4.8 p.p.m. in the treated waters. Such was accompanied by a marked increase in the free ammonia content also. This increase in organic matter, presumably due to algal growth, was apparently inhibited by the herbicide at a dosage as low as 12 gals. acre. Some nitrate reduction took place, but the chloride content of all samples remained unchanged, indicating that no hydrolysis of the Benoclor was taking place. The mate-

TABLE VIII

Effect of Outdoor Storage on Treated Water Removed from Dosed Area

Storage Days	Mean Temp. F° Air	Mean Temp. F° Water	Vapor Press. Diff. In Hg.	Ground Wind Est. Mil./Hr.	Threshold Odor Number—(65°C.) Raw Water	12 gal. Benoclor / acre	24 gal. Benoclor / acre
Start	52	48	0.137	0.8	15 musty	130 arom. chem.	300 arom. chem.
1	48	50	.190	2.4	15 "	130 " "	300 " "
2	42	42	.149	1.6	15 "	130 " "	300 " "
3	56	49	.060	1.8	15 "	130 " "	250 " "
4	64	61	.149	1.1	15 "	100 " "	140 " "
5	64	70	.256	1.5	12 "	30 " "	40 " "
6	59	61	.186	1.5	12 "	10 " "	15 arom.
7	47	50	.160	2.3	10 "	6 arom. musty	10 "
8	45	46	.191	1.9	8 "	6 " "	6 " musty
9	49	41	.041	0.8	8 "	6 musty	6 musty
					Chlorinated above samples with 0.9 ppm. chlorine—contact overnight. Removed residual chlorine before odor test.		
10					8 musty	8 musty	6 musty

rial appears to be extremely stable. Exactly how it disappears is not known, but of considerable interest is the fact that the odor disappeared in both cases after 6 days, although the ratio of dosages was 2 to 1—see Diagram B.

Summary of Results

1. The application of Benoclor 3 at the rate of 12 gal./acre imparted a characteristic aromatic chemical odor to water slowly passing through the treated lake. This odor persisted in the treated area for at least 12 days, but in diminishing concentration. It was entirely absent after 33 days.

2. The water from the treated lake, when displaced from contact with the dosed area, lost the characteristic aromatic chemical odor by:

a. dilution with untreated water.
b. absorption by organic matter in the water.
c. outdoor storage.
d. aeration.

3. No harmful effect on the water quality in a municipal water supply system was observed when Benoclor 3 was used in the feeder lakes under the controlled conditions prevailing, and as here reported.

Acknowledgement

The writer is indebted for the cooperation and assistance rendered by J. E. Badgely, R. H. Carver, and N. K. Pearson of the Union County Park Commission staff; and to Herman Seydel, President; A. H. Reiners, Chemist, and Burleigh Boyer, Engineer, of The Cloroben Corporation, Jersey City, N. J.

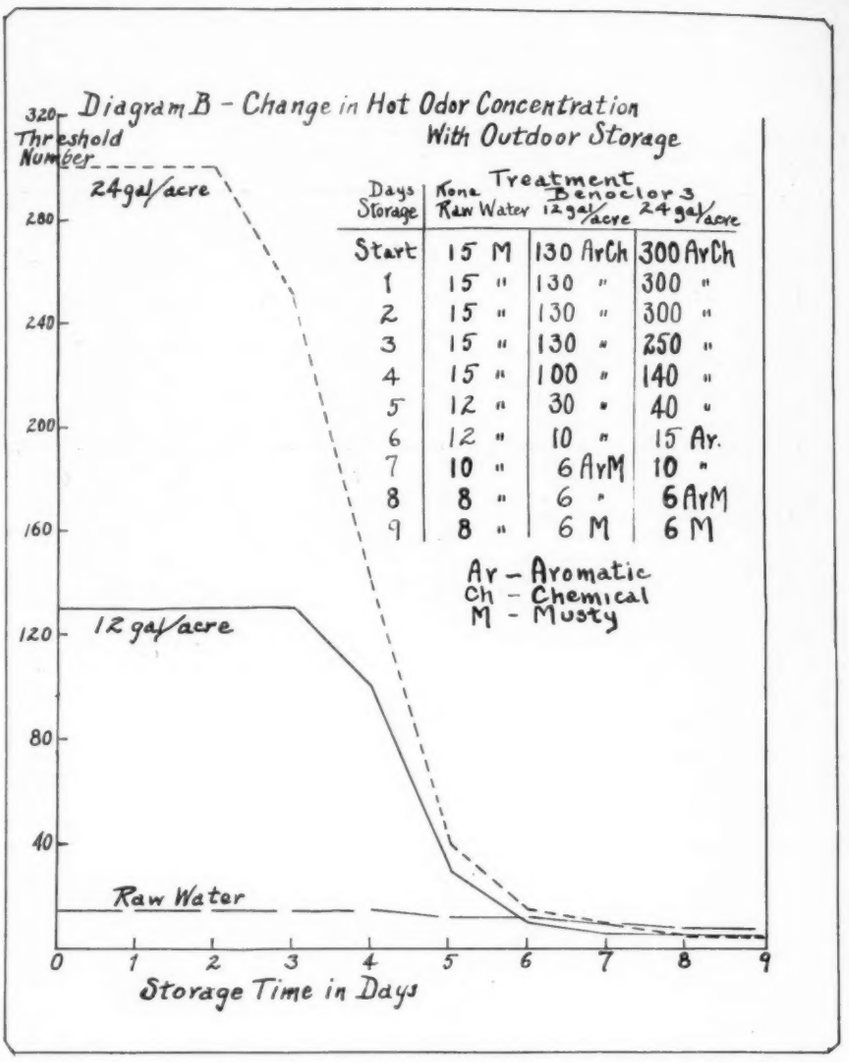


Diagram B - Change in Hot Odor Concentration With Outdoor Storage
Threshold Number
320
280
240
200
160
120
80
40
24 gal/acre
12 gal/acre
Raw Water
0 1 2 3 4 5 6 7 8 9
Storage Time in Days
Days Storage
None Raw Water
Benoclor 3 12 gal/acre
Benoclor 3 24 gal/acre
Start 15 M 130 ArCh 300 ArCh
1 15 " 130 " 300 "
2 15 " 130 " 300 "
3 15 " 130 " 250 "
4 15 " 100 " 140 "
5 12 " 30 " 40 "
6 12 " 10 " 15 Ar.
7 10 " 6 ArM 10 "
8 8 " 6 " 6 ArM
9 8 " 6 M 6 M
Ar - Aromatic
Ch - Chemical
M - Musty

Graphical Record of Study of Disappearance of "Benoclor" Odors During Storage.

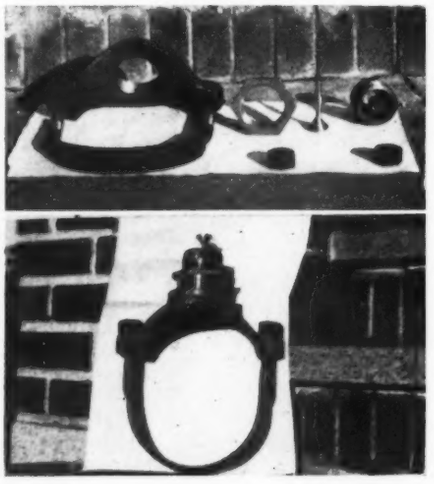
Note that odors from twice the dosage disappear in a period about the same as that for the lesser dosage.

NOZZLE REPLACEMENT ON TRICKLING FILTERS

By ROY S. LANPHEAR*
WORCESTER, MASS.

Flushing of the lateral distributors of the trickling filters at Worcester is done once each week by removing the end nozzle in each line, (several at a time) and allowing the dosing tank siphons to operate once or twice. The threads in the pipe openings, into which the nozzles were screwed, were destroyed after a few months of this routine operation. Cast iron pipe, brass nozzles and a sewage containing strong acid and alkaline industrial waste liquors were also factors in such destruction.

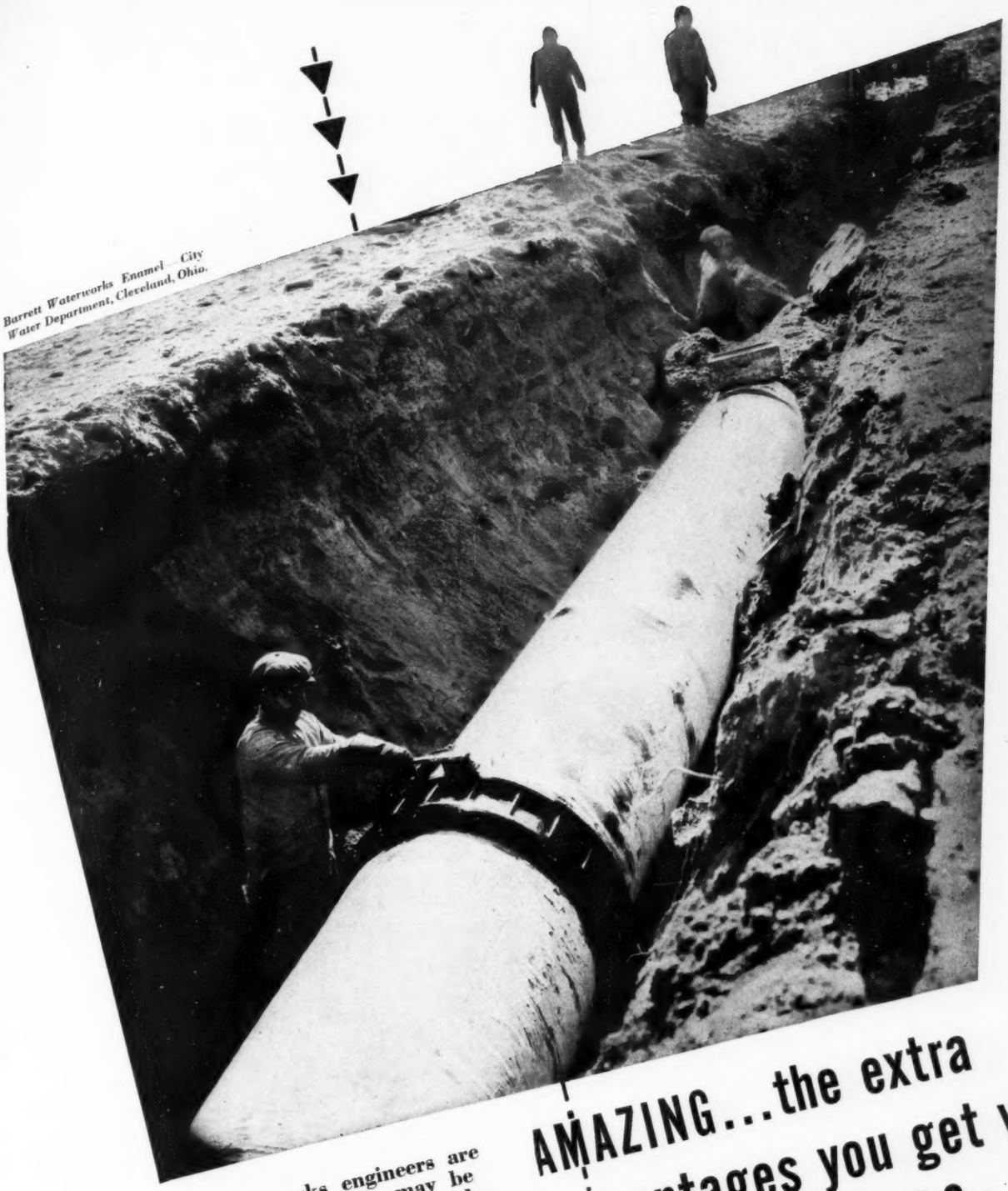
Saddles, with washers and U-bolts, were first used. When the threads in a saddle gave out, a new saddle was installed. This operation proved successful and was used for some time. Additional purchases indicated that while the method was a success, the expense was quite an item in the cost of filter operation. Apparently galvanic corrosion was at the root of the thread wearing difficulty.



A later improvement was the use of a 2½x2-inch brass bushing in the saddle opening. This left the contact of the iron and brass threads undisturbed when removing the nozzles. No difficulty is now experienced and saddles with the bushings have been in use since May 1937. In lots of 200 the cost of the saddles, strap-type U-bolts, and bushings, was 84, 58½ and 47 cents each, respectively.

The accompanying cut shows the several component parts of the successful assembly.

* Supervising Chemist, Worcester Treatment Works.



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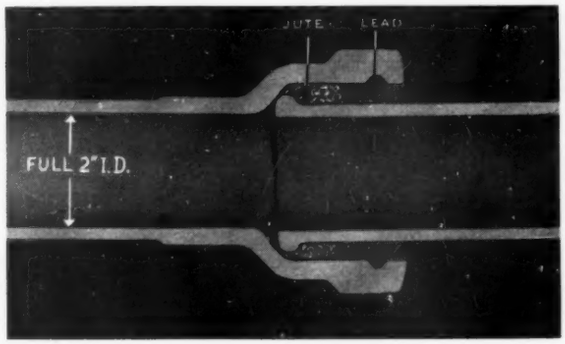

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NEW ENGLAND SEWAGE ASSN. MEETS AT MIDDLETOWN CONN.

A Report by GUY E. GRIFFIN
Sanitary Engineer
GREENWICH, CONN.

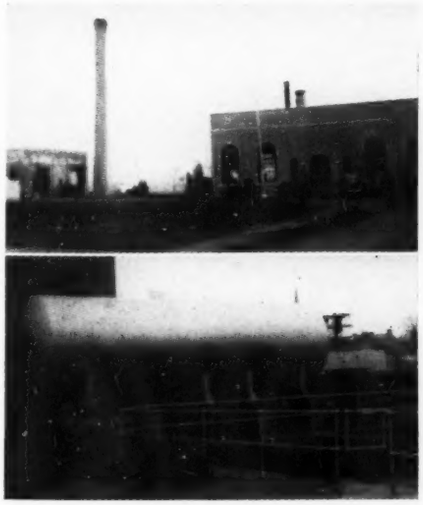
Middletown Boasts "High-Hat" Incinerator Operators.

IN contrast to usual procedure the program started with a morning inspection of the local sewage treatment plant and incinerator followed by lunch, business meeting, papers, a visit to Wesleyan University's Hall Laboratory of Chemistry, and dinner with a guest speaker. The date was April 16th.

The Middletown sewage treatment plant and garbage and rubbish incinerator are adjacent to each other. Both are under the direct supervision of Supt. Henry W. Bauer and the general supervision of Samuel C. Cannon, Supt., Dept. of Public Works.

The Middletown Plant

The treatment plant consists of grit chambers, mechanically cleaned bar racks, rectangular plain sedimentation tanks, rectangular, (fixed cover) sludge digestion tanks, with endless chain scum and sludge stirring mechanisms. All gas from the digestion tank is compressed to 25 lbs. pressure in a 27 cu. ft. horizontal, cylindrical gas holder installed over the digestion tanks. (See cuts.) The gas is burned at reduced pressure under a water tube steel heating boiler and on the lower hearth of a four hearth sludge incinerator. Digested sludge is conditioned with lime and ferric chloride and dewatered on a small unit type vacuum filter.



Middletown's Incinerator and Sewage Works.
(Below is the 2500 cu. ft. pressure type gas-holder installed on top of the digesters and operating under 25 pounds pressure.)

Filter cake and screenings from the bar rack are carried by belt conveyor to the charging hopper of the incinerator. Ash therefrom is elevated by conveyor to a point from which it can be discharged by gravity into a truck outside the building. Although the incinerator was operating during the inspection it was understood that most of the dewatered sludge is at present being taken by farmers.

At the luncheon Supt. Cannon stated that the plant was completed in early 1937 under a 45% P.W.A. grant. Construction costs for the plant alone were not given but a total of $456,000 was invested in the plant, inlet and outlet and some main sewers. The cost to the city was $240,000.

Treatment costs were said to be from $25 to $30 per million gallons, including interest, for an average flow of 1.2 to 1.5 m.g.d. Detailed annual cost figures given were:

Salaries and wages	$5,000
Fuel oil 10,000 gal.	600
Ferric chloride	700
Power	1,200

It was estimated by Mr. Cannon that the collection and use of approximately one million cu. ft. of sludge gas a year represented a saving of $600, apparently based on the gas value if an equivalent quantity had to be purchased at 60 cts. per 1000 cu. ft.

The 14 ton/day garbage and rubbish incinerator is of the single Decarie basket grate type. Preheated, forced draft is provided for the present and a future unit but is seldom used because of excellent draft from a tall chimney. That the incinerator has a "high hat" personnel is indicated by an accompanying picture of an operator in full "regalia."

Luncheon Session

The luncheon (125 attending) was held at Higgins Inn, opened for that purpose. Because of the illness of president A. D. Weston, the meeting was presided over by vice-president Walter J. Shea. Guests at the luncheon included Mayor Schaeffer, Health Officer Palmieri, and Board of Public Works member Marchese.

Following the luncheon, F. W. Gilcreas reported on the progress being made toward strengthening the Federation of Sewerage Works Associations. In this direction, he said that plans were under way for a Federation Convention, to be held in Chicago, during October, in conjunction with the annual meeting of the strong Central States Sewage Works Association.

Secretary Treasurer LeRoy VanKleeck reported that the association had a balance of $522 in its treasury and a present membership of 195 members. New members counted 30 and three members have been lost through death.

The Sewer System of Cranston, R. I.

The first paper of the afternoon was that presented by Ralph Horne, of the firm of Fay, Spofford and Thorndike of Boston.

The Cranston project involves a new, separate sewer system, including several pumping stations and a treatment plant. In the 50,000 design population (1970) 6,000 represents equivalent population in the form of industrial wastes.

Mr. Horne explained in detail and illustrated by slides the organization for employing approximately 2,000 W.P.A. employees. Design capacity was based on a study of present and future population as well as on water consumption, with allowances for infiltration and industrial wastes. Separate studies were made for areas zoned for different uses. From these studies diagrams were prepared for actual design use.

A study of pipe materials, based on all pertinent factors, gave ratings in the following order: (1) asbestos cement pipe, (2) reinforced concrete, (3) vitrified tile. Design and construction methods were somewhat influenced by the desire to utilize unskilled labor so far as possible. Although pumping station structures are to be built by W.P.A. labor, the furnishing and actual installation of equipment will be by regular contract.

A highly comprehensive system of cost accounting has been set up for the project. The cost is shared on the basis of 45.7% by the city and 54.3% by W.P.A. Some cost figures for 8 inch and 10 inch pipe (90% of which is 8 inch diameter) in 10 foot trench including service connection to the curb line, manholes and resurfacing has varied from $9.30 to $9.50 per foot. Some 14 inch pipe in difficult excavation has cost $12 per foot. [From the earlier statement we judge these costs apply to long length asbestos-cement pipes.—Ed.]

Pumping stations will be simple buildings over dry wells housing the pumps, with the wet wells outside. Operation will be automatic.

The treatment plant, not yet designed, will provide comminution of solids, primary sedimentation, aeration and final sedimentation. Effluent will be discharged into Naragansett Bay.

This sizable undertaking, started in June, 1939 and planned to be finished by March, 1942, probably could hardly have been undertaken without the aid of W.P.A. said Mr. Horne.

Sewage Gas Handling and Utilization

The second paper of the afternoon "Sewage Gas Utilization Systems" was presented by L. L. Langford, Eastern Sales Manager, Pacific Flush Tank Co., New York City.

Mr. Langford stated that to his knowledge the first attempt to collect and use sludge gas in this country was that by C. C. Hommon, then chemist at the Peachtree Creek plant of Atlanta, Ga. The gas from Imhoff tanks was used for heating and cooking. This was about the year 1915.

[The earliest American attempt to employ digester gas in power generation is thought to be that of W. M. Piatt of Durham, N. C., in the gas engine installed at Charlotte, N. C., about 1923. An installation at Rockville Center, L. I., followed shortly thereafter.—Ed.]

Mr. Langford, in discussing the two main hazards in handling sewage gas, stated that the proportion of air to gas to produce explosive mixtures ranges from 7 to 14 volumes of air to one of gas. Explosions may travel in pipe lines and enclosed chambers for considerable distances gaining in intensity and eventually producing a rupturing force. Because of this it is essential to prevent the entrance of air to any degree and to protect pipe lines from ignition. The prevention point should be as near as possible to the point of gas utilization. The most certain preventive measure is that of keeping the gas under a positive pressure at all times.

"The Greenwich Gang."

Plant Operators: Fred Schirmer (Old Greenwich); Rudy Goettle (Cos Cob); Paul Martzel (Grass Island); Ben Lyons (East Port Chester).

Sources of ignition may be any point where the gas is burned and all such points should be isolated by some form of anti-back-flow protective device. The generally accepted device is a flame trap, of the type which operates on the principle of the screen of the Davy Miner's Lamp. These units are so designed that a flame can burn on one side of a screen element of sufficient size to radiate the heat sufficiently to preclude igniting the gas on the other side. For further protection a so-called "fusible-link" is incorporated. This link easily melts and permits the spring loaded valve to close sharply, thus shutting off the gas flow. Such flame traps, however, should be inspected occasionally to see that they will close effectively and quickly. Experience has shown that deposits have on occasion caused the valve stem to stick.

Flame traps of the water seal type should be checked frequently to maintain the proper water level since a lowering of the level reduces its effectiveness. All such seals should be vented to outside atmosphere *only*.

Due to the possibility of gas leakage, all structures where such a possibility exists should be adequately ventilated in any event.

With regard to design and operation of gas systems, Mr. Langford made several suggestions.

Control devices and the gas system as a whole should be of adequate size to assure proper operation under all conditions of gas production and consumption. Losses in pressure should be kept at a minimum and some studies indicate friction losses in gas lines to be considerably in excess of those expected when employing available formulae. This may be due to accumulations of solids or moisture in the lines. Since the gas leaving the digestion unit is very nearly saturated, if not completely so, it will give up moisture on cooling. It is *imperative,* therefore, that all gas lines have adequate slope to low points at which safe provision must be made for removing the condensate.

Gas in excess of that used must be discharged to the atmosphere with or without burning. To prevent nuisance from odors it may be burned in a waste gas burner which should be provided with a pilot, and *both* pilot and main burner should be isolated by flame traps.

Gas boilers because of their usual fully automatic operation are too frequently neglected. Mr. Langford laid stress on the importance of frequently checking the automatic controls by making them function. This, in order to be certain that they will function automatically when called upon to do so. Boiler rooms should be well ventilated to prevent the danger of oxygen deficiency. Care should be taken when providing artificial ventilation to preclude possibilities that a backdraft will be produced in the chimney as a result.

Gas storage becomes desirable where gas engines are used and this subject should be studied from a standpoint of economy. Storage may be in gravity type holders of either the water seal or piston type or under

(1) *Harry Smith (Stamford); E. S. Chase (Boston); Jay Wilson (Greenwich); Prof. Camp (M.I.T., Cambridge, Mass.).*—(2) *"Gill" Pratt (W.&T.Co., Boston); F. W. Gilcreas (Immediate Past Chairman and long Secy.-Treas. prior thereto).*—(3) *Henry Bauer, Sup't. of the Middletown plant, with a group at his plant.*

pressure in cylindrical or spherical holders.

For proper operation of a gas system two most essential things for the operator to know are: (1)—the quantity of gas produced and (2)—the pressure at different points. The first may be accomplished by metering and the second by simple U tube gages for pressures commonly encountered. A knowledge of the quantity of gas produced gives a clue as to the proper functioning of the digester, and metering of gas used by various devices furnishes a method of checking their efficiency. Checks on pressure and pressure losses in a system may be of decided advantage in locating difficulties such as leaks or stoppages.

Mr. Langford showed a number of slides of gas system installations and commented on them. Some of the most interesting comments are given here.

Safety devices such as flame traps and pressure reliefs, should be so installed as to be easily accessible for checking.

Meters should be installed at a convenient place and proper height for reading. Gas boilers, particularly small ones, might well be placed on a built up base, for ease in examining the flame and should be kept well away from walls for ease in cleaning.

(1) Walter Shea, Chief Engr. Bd. Water Purif., Providence, R. I.; Leonard Treger, Engr., New Hampshire State Dept. of Health; Edw. C. Johnson, Chemist, Bd. of Water Purif., Providence, R. I.—(2) Chief Engineers, C. L. Pool, R. I. Dept. of Health, and Warren Scott, Conn. Dept. of Health.—(3) John Brooks, Sup't. of Sewerage, Worcester, Mass.; Wm. Petri, Plant Supt., Norwalk, Conn. (Vice-Pres. of the Association); Ed. Rothman, W.&T.Co.

Sewage and Waste Treatment Studies

Following Mr. Langford's paper, Prof. C. R. Hoover of Wesleyan Univ. spoke briefly on the Research Work on Sewage and Industrial Wastes being carried out under his direction at the University.

Thereafter, a visit was made to Prof. Hoover's laboratory where, amongst other studies, sludge was digesting in bottles to which salts of different metals had been added in varying quantities to learn their effects on sludge digestion.

An experimental trickling filter was treating a difficult organic waste from a printing plant. Wastes from a plating plant, deep yellow with chromium, were being decolorized with sodium sulfite.

Although located in a basement and not beautiful to look at, it was quite evident that Prof. Hoover's laboratory was producing results that bid fair to benefit many industries and sewage treatment plant operators.

Safety Code Placards

During and after the meeting the new "Safety Code" Placard, was distributed without charge to members. This placard is of heavy cardboard suitable for posting in the plant. The Code incorporates recommendations set up by the Joint Committee on Safety, composed of members of the New England and N. Y. State Sewage Works Associations.

UNIQUE SCHEME OF FLOATING OUTFALL SEWER INTO POSITION AND LOWERING*

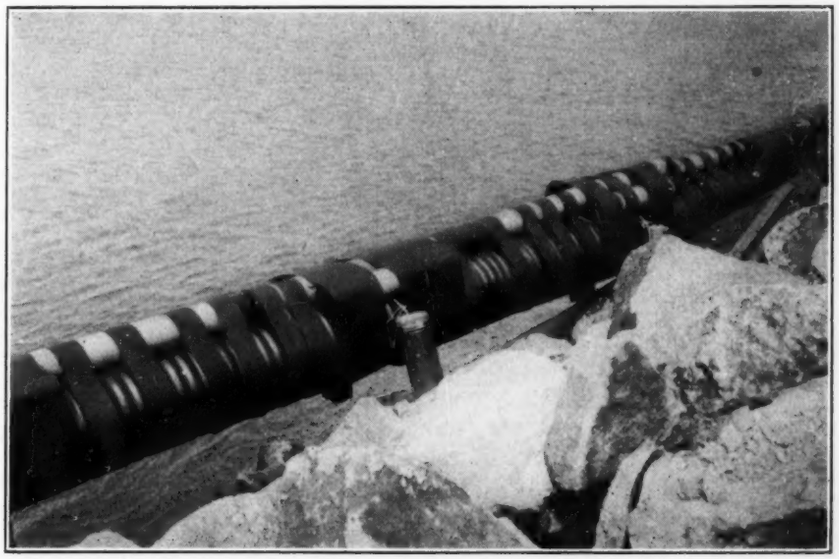
Spiral Paper Tubes Used on 1,000 Ft. of Pipe

The 1,000 foot Golden Gate Exposition outfall sewer into San Francisco Bay is constructed of corrugated iron pipes. The joints were not made up to withstand any appreciable longitudinal deflection or stress, such as would be experienced in the process of rapid lowering by allowing its free fall to the bottom of the deep bay.

To secure some degree of controlled buoyancy during the lowering procedure such was accomplished through the expedient of employing a calculated number of capped end tubes of water resistant waxed paper. These tubes, which were made for shipping rugs, were strapped in sufficient number to the pipe (some 2,000 ft. of them) to provide buoyancy equal to 29 pounds per square foot of pipe. Thus the weight of the 18-inch pipe, when filled with water, was reduced to about 2 pounds per lineal foot.

It was calculated that under this condition the string of pipe would fall free to the bottom, 38 ft. down, in 15 seconds. (Actually the timed drop checked remarkably well with that computed.) The outfall line was submerged by removing a temporary closure from the deep water end of the line after floating it into position on a quiet day.

To cut the roofing paper wrapping, holding the tubes to the pipe, a wire (16 gauge) ran the length of the 1,000 ft. string of pipes beneath the wrapping strips. When on the bottom the ends of the wire were pulled, cutting loose the wrapping and releasing the tubes which popped up to the surface in a most interesting manner, looking like game fish jumping for flies.



Portion of 18" Corrugated Iron Outfall Line
Showing buoyancy tubes strapped in place on shore before floating into position for lowering.

*Contributed by Chas. W. Geiger, San Francisco, Calif.

DRY FEEDERS

Some Notes on Design, Maintenance and Operation

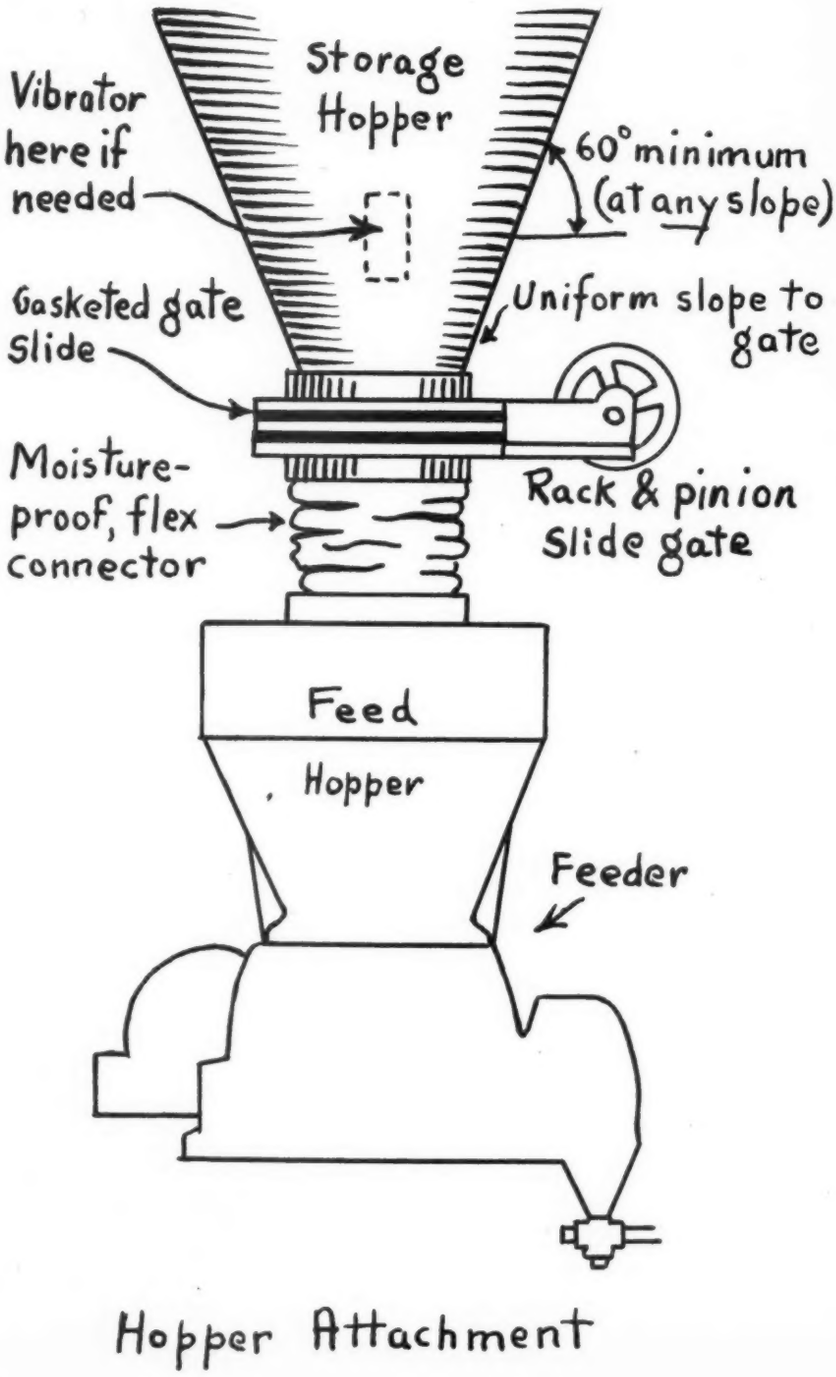
By F. J. LAMMERS
INTERNATIONAL FILTER CO.
CHICAGO

PROPER maintenance of chemical feeders has been greatly simplified by constant improvement in design and manufacture—but a few comments on application and operation may be helpful nonetheless, especially in handling a problem of unusual type of service.

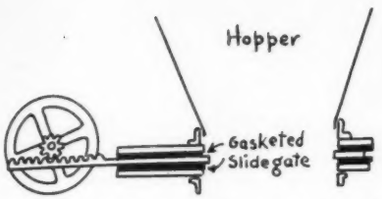
Intermittent Operation

Intermittent operation may cause chemical to cake, scale or lump in the feeder mechanism, due to absorption of excess moisture from the air. Especially is this the case with lime, alum and sodium aluminate. If the usage is widely intermittent, it is best to run all chemical out of the feed mechanism before shutting it down, and a positive acting shut-off gate between large supply hoppers and the feeder proper are important for this purpose. Such gates are later described under "Hopper Gates."

When periods of inoperation, or those of exceptionally low feeds, do not extend beyond a few days at a time, this difficulty can often be remedied by placing an ordinary electric light bulb in the most effective position to heat the chemical immediately in and above the feed mechanism. This will usually eliminate sufficient moisture to prevent severe lumps or scale. In feeders of the revolving table type, the bulb should be placed under the table, and as near as permissible to the adjustable deflecting knives; roller or shutter type of feeders should have the bulb close under the feed element; with screw, vibrating or gravimetric type feeders, the feed channel may be too long for adequate heating by a single bulb, and a small resistance



Hopper Attachment



Rack & Pinion, dustproof Slide Gate

element may be preferable. In the case of powdered carbon, however, the use of exposed heating elements is to be avoided, because carbon dust is flammable. Both storage and feed hoppers should be made as tight as possible with gasketed covers, and any flexible connections between these hoppers should be of fairly moisture-proof material, or suitably painted fabric, to seal them.

Hoppers

Arching in either the storage or the feeder hopper is largely a matter of original design. The hopper slope preferably should be at least 60 degrees from the horizontal. This applies to the corner joint as well as the flat of square hoppers, since arching often starts because this slope at the corner is insufficient. However, arching can be reduced if hopper covers are filleted, or slopes steepened. To hoppers with flexible walls alternating current vibrators may be attached to keep the chemical moving down the sloping walls (see sketch).

Hoppers should always be equipped with screens, and these kept in place, to prevent entry of oversize material. Chemical sacks should not be opened over the hopper, as this invites the entry of troublesome string or bits of sacking which may foul the feed mechanism.

Hopper Gates

Hopper gates should work easily to permit convenient shutoff of chemical: for this purpose, sliding gates are best when equipped with rack and pinion drive, so that destructive hammering is unnecessary for opening and closing them. Hopper gates of the rotary type and so-called "bin-valves" are available as refinements for this purpose. Where there is likelihood of frequent shutdowns such gates are especially worthy of consideration.

Chemical Discharge

After measurement, most dry feeders discharge chemical by gravity into a stream of water, usually in a vortex funnel of mixing chamber. At this point the amount of flow, and especially the velocity, must be sufficient to wet and sweep away the maximum chemical. A tangential water inlet is preferable, to create a swirl and vortex for maximum wetting; if velocity is insufficient for complete removal of all chemical, such may be increased by reducing the size or altering the shape of the inlet orifice. The water flow should not flood and close the vortex, or chemical wetting will be impaired.

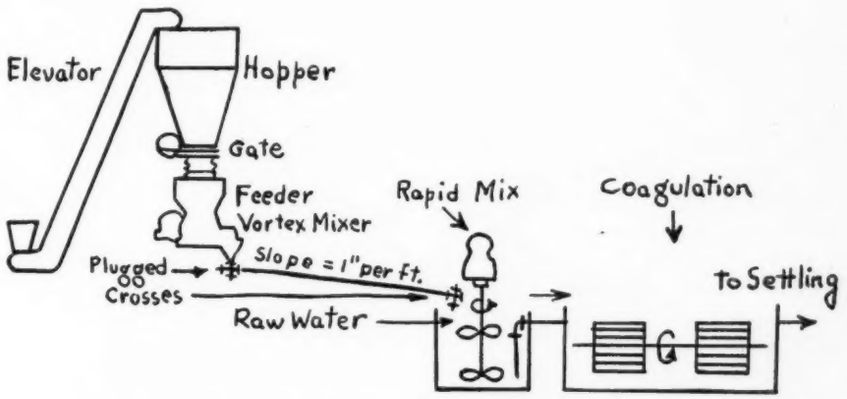
Feed Lines

The pipe lines carrying the wetted chemical to point of application should pitch at least 1 inch per foot and should have either large radius bends or, preferably, plugged crosses at each 90 degree turn, so that the lines may be readily rodded out. The discharge end should preferably *not* be submerged. Or, if submerged, the line should be vented to prevent backing up of water and to release entrained air which might otherwise produce an air lock. Also it is possible that such entrained air may be occluded by the floc, causing it to have a tendency to float (see sketch).

Dissolving Devices

Vortex funnels and ejectors mainly provide mechanical removal of the measured chemical, and may not dissolve any great part of it. Subsequent agitation in a dissolving chamber should be provided for true solution, otherwise undissolved chemical may settle to the bottom of the mixing basin and be wasted. An initial, violent, short mixing of the chemical with the full flow of liquid being treated, ahead of slow coagulating mixers, will assure solution and distribution of all chemical.

(This brief article was requested from the author, after hearing him give some of these pointers in a floor discussion during a recent meeting. —EDITOR.)



Dry Feed Installation Layout

A "WATER SUPPLY PROTECTION WORKS"

Novel in Water Works & Sewerage Field

Kenosha, Wisconsin, desirous of constructing a sewage treatment plant in 1937 found that it lacked satisfactory collateral with which to obtain a P.W.A. grant for the purpose.

Then, the expedient of raising the needed funds by placing a mortgage on the local water works seemed a way out. The Public Service Commission of Wisconsin was appealed to for permission to place such a mortgage on the water works in the amount of $500,000 for the specific purpose of building the needed sewage treatment plant and securing the 45% P.W.A. grant.

In the application the proposed plant was referred to as a "Water Supply Protection Works". The placement of the $500,000 mortgage on the water plant was allowed by the Commission. Now Kenosha has two water treatment works—one for "new" and one for "used" water.

Kenosha's "Water Supply Protection Works" is being financed and operated by the Water Department, with a minimum of added expense to the City for effective sewage disposal and water supply protection under a single management, but expanded organization.

25 SIGNS OF THE Master Salesman

By J. GEORGE FREDERICK
NEW YORK, N. Y.

The author of this article, now president of the Business Bourse, wrote "Modern Salesmanship" and "Modern Salesmanagement." This article originally appeared in FORBES Magazine. We found it interesting enough to justify asking permission to reprint it, in hopes that some of our friends from amongst the "ambassadors of commerce" will find it worthy of the space given.

1. His Approach Is Positive. His bearing, attitude and performance carry no hint of an apologetic attitude because he knows that he brings business-like information; assumes that his prospect is a good business man who will welcome it; is conscious that he is pursuing an honorable profession; is certain that he is going to use up not a minute more of the prospect's time than is economic; and is confident of his preparedness to meet any and all sales resistance.

J. George Frederick, president of the Business Bourse, is an expert on selling methods, author of "Modern Salesmanship" and of "Modern Salesmanagement."

He is a time manager

2. He Always Knows the Buyer's Needs. He is attentive to "pre-approach" analysis, and takes nothing for granted. He is a digger for prospect facts, and bases all his statements about a prospect's needs on those facts.

3. He Wants Orders, First and Last. What he wants is not personal appreciation or interest in himself, but an order. He knows that making a personal hit with a prospect, while the order is forgotten, spells salesmanship failure.

4. He Knows He Is Not Invincible. He does not feed on inspirational nonsense about selling, and work up an idea that he is an unbeatable wonder. He knows that he will fail occasionally, so he takes pains to be so well prepared that he seldom fails.

5. He Never Relies on "Pull." He never falls for the tyro's idea that it is not *what* you know but *whom* you know that counts. He never relies on relatives, connections, "pull" or selling everybody in an organization *except* the constituted purchasing agent. He assumes that his case has enough merit to go direct and cold.

6. "Satisfactory" Does Not Satisfy Him. What an ordinary salesman would call satisfactory knowledge of his line, does not satisfy him. He digs, and digs again and again, for all kinds of data about his line, and the industry of which it is a part. He follows his line into ultimate consumption for fullest information.

7. He Never Uses the Good Fellow Racket. The master salesman is a business man; he is conducting the most intensive, concentrative and vital operation of the whole business technique. It does not call for relaxing, social, humorous, idling attitudes and methods, small talk and good-fellow palaver.

8. He Avoids High Pressure. All "high-pressure" selling techniques have the basic defect of pushing the prospect around, usually in a daze from which sometimes he awakens —to resentment. The master salesman makes only sales that stick, because of genuine, lasting conviction. He has other, better methods for special difficulties.

He never uses high pressure

9. He Is Never Competitor-Conscious. No salesman dares forget competitors; but the master salesman never becomes obsessed with them. He neither over-rates nor under-rates competition, and he sees to it that his own selling is not too much colored and swayed by it, since it hurts the individuality of his house, as well as his goods and himself.

10. Routine Calls Are Out. He never "just drops in," with "nothing on his mind," just to "keep in touch." He knows that this deflates the value of the call. He makes *all* his calls important—or he doesn't make them.

11. He Talks as an Individual. He can trust his "ad lib" talk to be top-grade selling talk. Like all salesmen, he must use fixed technical de-

scriptions or key slogans or small standardized, "tested" phrases; but he knows that these must be as few as possible, while the individual adaptation of the argument to the prospect must be as extensive as possible.

12. He Is a Giver Rather Than a Getter. He visualizes his prospect not as someone from whom he is going to *take* something (an order); but as someone to whom he is going to *give* something (higher efficiency, more sales, better profit, better service, lower cost, etc.). This puts more confidence in his manner, and compels him to prepare proof of his claims more carefully and factually.

13. He Is a Master Gentleman. The master salesman is no mere tailor's-dummy gentleman; he is a gentleman by instinct and quality, even if not to the manor born. He is meticulously gracious, sportsmanlike, self-possessed, considerate, well-mannered, adroit, poised, appreciative.

14. He Is an Intensive Time-Manager. No one knows better than he the preciousness of time. He is a demon for clipping off needless time waste; a strategist and master planner of his day's activities and movements; a martinet for promptness in appointments and get-aways; a ruthless disciplinarian of his habits and hours of work; a hard man to persuade to lounge or dally during business time.

15. He Is Hard to Shake Off. He *expects* resistance, impatience, "final" dismissals and all the rest. They do not deter him. He has made sure of his facts; he knows that he has a good business case against his prospect's no; and this is the crack which he confidently expects to split wide open—if not today, then tomorrow.

He avoids rubber stamp talk

16. He Criticizes His Own Performance. Having no puffed vanity, he knows that he makes mistakes, and he is always after them like a dog on the trail of a rabbit. He is thoroughly "objective" about himself.

17. He Has a Sense of Humor. But he is no jokester; he uses his sense of humor upon himself, to keep his balance and sense of proportion.

18. He Uses the Law of Averages. The master salesman doesn't believe in miracles. He puts arithmetic to work for him. He knows the statistical averages concerning his performance, just as Joe DiMaggio and every other major league player does. If business slows up, he raises his average number of sales presentations per day, and therefore keeps his performance about even.

19. He Builds Customers. The hall mark of the master salesman is that he is welcome to come back. He builds customers instead of only making sales; he makes not merely a passing buyer but a permanent customer out of his prospect. He knows that this reduces the over-all load of selling costs per sale.

20. He Watches Little Things. The master salesman's performance is smooth and seemingly effortless because he watches the little things that make or mar sales. He knows that he can smoke at the wrong moment while selling; that his approach can be too dynamic; that he can be too slow or timid about asking for the order; that he can have little personal traits which antagonize; that his ties can be too loud; that he should never talk politics or religion; that he must guard against many other "little-big" things.

21. He Understands Human Psychology. Not just rule o' thumb, superstitious fallacies, but authentic modern psychology. He reads up on it constantly. He knows the principles of appeal and response; the principal types of human creatures one encounters; the instincts and desires, the driving motives, moods, and states of mind. He knows that modern psychology is developing constantly new and valuable data.

22. He Has No Prima Donna Temperament. Four out of five reputed "brilliant" salesmen have prima donna temperaments; they are difficult to manage, and in the end unreliable. The master salesman is definitely not "brilliant"; his master qualities arise from steady performance. He is not subject to moods and "down" periods.

He never depends on pull

23. He Has Accuracy and Technical Capacity. The master salesman has technical capacity; he understands detailed mechanical and other techniques, can be trusted to get his figures right and to make an impression of responsible handling of affairs. The master salesman does these things, where called for, not only accurately but also helpfully and with creative understanding, constructive imagination.

24. He Is a Student of Salesmanship. Every decade new factors enter salesmanship; its practice must improve or be labeled obsolete. The master salesman keeps actively in touch not only with advancing standards of the general art of salesmanship, but with the job above him, salesmanagement, as well.

25. He Picks His Job with Shrewd Care. No master salesman wants just *any* job of selling; he knows that he is no superman capable of selling the unsalable. At the same time, he prefers a hard selling job; but it must be a sound selling proposition, so that he may give himself up unreservedly to his task, and stay on it resultfully for a reasonably long period of time.

(Perhaps you would like to rate yourself as a salesman on the basis of these qualities outlined by Mr. Frederick. It is easy to do. Simply allow yourself four points for each of the signs which point in your direction; add them up and you have the answer. If you want to double-check your standing, have a friend do the rating. You may not agree with the author on every count, but the result should give you a fairly accurate picture of your own abilities by modern standards of salesmanship.)

Photographs: Kaufmann & Fabry(3); Charles Phelps Cushing(1).

A QUESTION WELL ANSWERED

"WHY KANSAS CITY?"—

This question was well answered April 21-25.

In the minds of many members of the American Water Works Association, when its Directors chose Kansas City as the place to hold the 1940 Convention, was the question—*"Why Kansas City?"*

As a matter of fact this question became more than that. It took on a tone of criticism of the judgment of those in A.W.W.A. charged with the choice of convention cities, and of the wisdom of the Board which must hear and question the Convention Place Committee and, thereafter, approve or disapprove its selection and recommendations. In short, the decision in favor of Kansas City (which seemed to be something of a "dark horse" in the race, between cities contending for the 1940 Convention) proved to be anything but a popular decision with 1939 conventioneers at Atlantic City.

As a matter of fact, following the 1939 convention, much criticism was directed to and at A.W.W.A. headquarters—so much so that an editorial in the August 1939 issue, captioned "Why Kansas City?", constituted an attempt to get together the more pertinent "Whys," and to set forth the basic considerations which prompted the unpopular choosing of Kansas City.

Amongst the "Whys" set down was the fact that the geographic location was such as to provide an easily reached water-works convention of national scope to great numbers of operating men (those in particular in the 600 mile zone surrounding "The Heart of the Nation") who had never had such an opportunity given them before. This was perhaps the most important consideration.

Another "Why" — admittedly one of some weight with those charged with convention arrangements and in the making of conventions that "click" were the local facilities. The latter embraced the outstanding accomodations offered in Kansas City's remarkable and excellently managed Municipal Auditorium, surrounding which is a constellation of hotels offering reasonable rates and highly satisfactory accommodations for conventions which have reached a magnitude too great for satisfactory housing of exhibits and convention attendance in a single hotel or even two hotels. The "white man's treatment" accorded by Kansas City Hotels, together with the reputation of the K.C. Convention Bureau for the "know how" and performance, as attested by many testimonials from "satisfied customers" amongst other sizeable associations, proved no little weight on the side of members from Kansas City and the Missouri Valley Section, avowing that it would be their job to see that A.W.W.A. never before had such a successful convention.

The next question is—Did the members in the Kansas City territory come through with their promises? Our answer is—Just take a look at the record; further, just ask any who attended the Kansas City Convention. If there ever was an A.W.W.A. Convention that came nearer to being the acme of conventions it was without question that in Kansas City.

Never has there been an A.W.W.A. convention where the attendance record reached its high point so early in the week, to establish an all time record. They came early and stayed through to the end. There never was an A.W.W.A. convention which had been so thoroughly and effectively promoted in the contiguous area. There probably never was an A.W.W.A. convention where manufacturers found a higher interest in or enjoyed greater attention to their exhibits. There never was an A.W.W.A. convention in which local arrangements had been better handled by local committees to produce as smoothly oiled machinery. There never was a convention in which every one was more happily pleased; never one with fewer grumbles; never one which so well clicked at the start and kept clicking to the end.

Yes, Kansas Citians promised a good convention and went to work to make doubly certain of such, when the questioning of "Why Kansas City?" got back to them. To sum it all up: If there ever was a question more effectively and satisfactorily answered it was this one. We said in pre-convention issues that the Kansas City convention had all of the ear-marks of being a "sell-out"—and so it proved. Now we can say that the 1940 Convention has left foot-prints which establishes a stride that Toronto in 1941 will find hard to outdistance.

When we examine the record of geographical distribution of attendance and what the 1940 convention yielded in attainments and net results, the judgment of A.W.W.A.'s Executive Secretary, and those who took on the responsibility with him in choosing Kansas City as the 1940 Convention place, has been amply confirmed.

Possibly this may explain why we have heard hardly a peep as to "Why Toronto?". And, let's also recall in passing that the last A.W.W.A. Convention in Toronto proved a high-water mark amongst conventions. With the rate of currency exchange what it is now and what it bids fair to be in 1941, we suggest even this far in advance, "Watch Toronto!"

LEWIS VAN CARPENTER
1895-1940

His name stood for all that it signifies—*the builder.* He was born and reared in Wheeling, W. Va., where they make things of steel. And, he had all of the qualities of this unsurpassed material with which the builder reaches skyward and builds permanence and virility into his structures.

His second name, Van, signifies being out in front. And, this is where he found himself with a singular ability of staying there.

What his first name, Lewis, stands for we are not certain, but we will interpret it as signifying a pioneering spirit, fearlessness and leadership — for all three qualities he possessed.

With it all, if he were asked to select a single phrase for his epitaph we feel sure that it would be *"The Teacher."* And, like many, we shall always remember Lewis Carpenter as that.

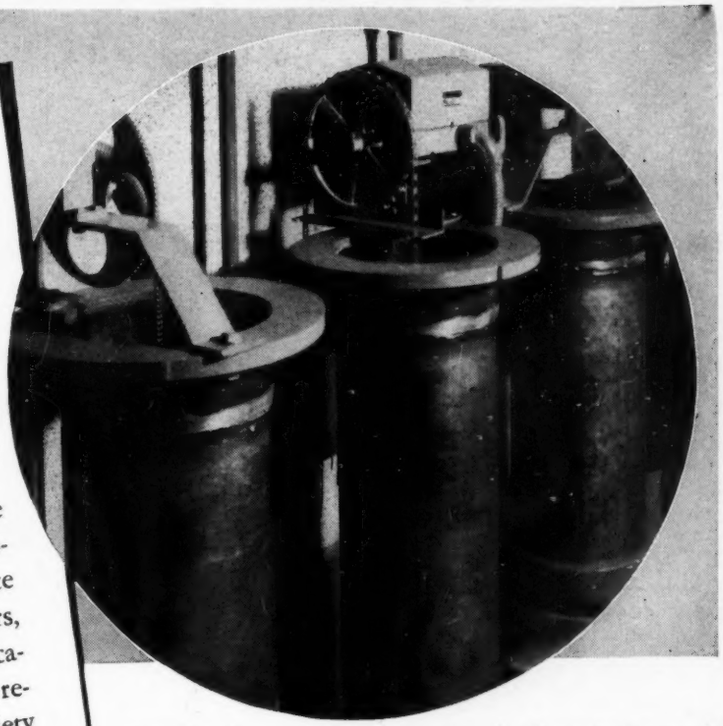
L. H. Enslow

Everdur

is backed by competent advisory service

Engineers of The American Brass Company offer their assistance in advising on any problem having to do with the application of this copper-silicon alloy to sewage, reservoir, or waterworks service.

Their experience covers a period of twelve years during which EVERDUR has established a unique record in these fields. Since 1927, for fine screens, gates, aprons, weirs, and many other sewage treatment applications, it has shown uniformly excellent resistance to corrosion through a wide variety of operating conditions.



Control mechanism of 12" diameter Everdur float tubes. Designed and built by Krajewski-Pesant Mfg. Corp., for the Ward's Island Sewage Treatment Works of the City of New York.

Only EVERDUR combines—

1. High resistance to corrosion . . . **2.** High strength, permitting lightweight construction . . . **3.** Ease of fabrication . . . **4.** Ready weldability . . . **5.** Moderate cost.

Everdur Metal is available in all commercial forms and can be readily fabricated by substantially the same procedures used with steel, including welding. Let us send you Publication E-11 which describes the use of this Anaconda alloy in the sewage treatment, reservoir and waterworks fields.

• • •

One of nine gates installed in the Richmond-Sunset Sewage Treatment Plant of the City and County of San Francisco, Cal. The gate bodies are EVERDUR castings, the lifting stems were made of 1-1/2" EVERDUR rod, the guides from brake-formed EVERDUR angles. All reinforcement cross bars, as well as all nuts, bolts, washers, etc. are EVERDUR. Equipment fabricated and installed by the California Corrugated Culvert Company. 39148

ANACONDA **Everdur Metal**

Visit the Copper & Brass Industry Exhibit in the Hall of Industry, New York World's Fair—1940.
(C) N. Y. W. F.

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

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"EVERDUR" is a trade-mark of The American Brass Company, registered in the United States Patent Office.

Whether the flow calls for a 5/8 inch Venturi or for a 13 foot tube—

VENTURI TUBE, 13 feet diameter with throat 8 feet diameter at the Pittsburg, N. H. Flood Control Project of the N. H. Water Resources Board. Richard S. Holmgren, Chief Engineer, Charles T. Main, Consulting Engineer.

Specify

BUILDERS *Venturi*

On the downstream side of the impounding reservoir at the Pittsburg, N. H. Flood Control Project this 13x8 foot Venturi Tube (in parallel with a 42 inch Tube) will enable the engineers to record all flows from four million to one billion gallons per 24 hours.

Thus does Venturi continue to serve!

If you have a problem of flow metering, controlling, chemical feeding, or level gauging we can probably help you, too. Address,

BUILDERS IRON FOUNDRY

"QUALITY, a tradition for over 100 years"

9 Codding Street Providence, R. I.

QUICK . . .

Mount Akron! Removed From One Akron, Ohio, Sewer with OK Champion Equipment

The velocity of 1,300,000 gallons in 24 hours through a 12 inch sewer is 2½ feet per second.
And that's just the speed of the

OK Champion Sewer Cleaning Bucket

as it goes through the sewers in normal operation. Never before has sewer cleaning been even half so important in your sanitary program. Many sewers are 30, 50 or more years old. They need a carbon cleaning and valve grinding job to run right again. Tons of cinders wash down from streets on which they were scattered for non-skid protection during the winter. Costly sewage disposal plants are designed to handle sewage—NOT dirt and debris.

Clean them at low cost with the latest tools. 3½, 5 or 7c per foot are average costs. Sand, roots, gravel, stones, sticks, junk or what have you are removed as easily as a power shovel excavates for a basement. Don't wait until you HAVE to do it. Make sewer cleaning a routine operation. Get on sewer cleaning before the clogged sewers become an epidemic—and a headache.

The OK Champion line is most complete. Motor power cleaners, hand power cleaners, buckets, sewer rods, and all accessories.

We will be glad to send you literature.

Champion Corporation

4714-38 Sheffield Hammond, Indiana

Aren't These the Features You Want In a RATE OF FLOW CONTROLLER?

THE INFILCO Type CD Rate of Flow Controller is sensitive to even the slightest fluctuations in flow. It has no stuffing boxes, pivoted levers, cumbersome counterweights or other extra gadgets to get out of order. And to assure positive action it does no work beyond *controlling* the hydraulic mechanism that actually operates the valve.

The rate is easily set by turning a knob over a calibrated dial on the front of the controller; the reset feature prevents even momentarily exceeding the normal operating rate when the flow is stopped and then started again. Head loss is but a fraction of a foot. The overall laying length is short to conserve space.

Write for Bulletin

For more information on these and other features, write for Bulletin 500.

INTERNATIONAL FILTER CO.
325 W. 25TH PLACE, CHICAGO, ILL.

INFILCO

MEETINGS SCHEDULED

May 16-17—Salisbury, Md. (Wicomico Hotel)
Maryland-Delaware Water & Sewerage Associations. Secretary, A. W. Blohm, 2411 North Charles St., Baltimore, Md.

May 16-18—Jacksonville, Fla. (Hotel Seminole)
Florida Section A.W.W.A. Secretary, A. P. Black, University of Florida, Gainesville, Fla.

May 20-21—Catalina Island, Calif.
California Sewage Works Association. (Spring Conference). Sec'y., Fred D. Bowlus, 202 Law Bldg., Los Angeles, Calif.

May 22—Trenton, N. J. (Stacy Trent Hotel)
New Jersey Section A.W.W.A. (Spring Meeting). Sec'y., C. B. Tygert, P.O. Box 178, Newark, N. J.

May 22-24—Chicago, Ill. (Congress Hotel)
Illinois Section A.W.W.A. Secretary, H. E. Hudson, Jr., 6843 Oglesby Ave., Chicago, Ill.

June 3—Baton Rouge, La. (Louisiana State University)
Louisiana Conference on Water Supply & Sewerage. Followed by Short Course in Water and Sewerage June 4-6.

June 6-7—Ithaca, N. Y. (Hotel Ithaca)
New York Section A.W.W.A. (Spring Meeting). Secretary, R. K. Blanchard, 50 West 50th St., New York, N. Y.

June 12—Poland Spring, Me.
Maine Water Utilities Association. Sec.-Treas., Earle A. Tarr, Winthrop, Me.
(Meeting Jointly with)
New Hampshire Water Works Association. Sec'y.-Treas., L. W. Trager, State Dept. of Health, Concord, N. H.

June 20-22—Syracuse, N. Y. (Hotel Syracuse)
New York State Sewage Works Association. Sec.-Treas., A. S. Bedell, State Dept. of Health, Albany, N. Y.

June 24-28—Atlantic City, N. J. (Chalfonte-Haddon Hall)
American Society of Testing Materials (Annual Meeting). Sec.-Treas., C. L. Warwick, 260 So. Broad St., Philadelphia, Pa.

June 24-26—State College, Pa. (Nittany Lion Inn & Dormitories)
Pennsylvania Water Works Operators' Association. Annual Convention. Sec.-Treas., I. M. Glace, Consulting Engineer, 22 So. 22nd St., Harrisburg, Pa.

June 26-28—State College, Pa. (Nittany Lion Inn & Dormitories)
Pennsylvania Sewage Works Association. Sec.-Treas., L. D. Matter, Distr. Engr., Kirby Health Center, Wilkes Barre, Pa.

Aug. 14—Boothbay Harbor, Maine
Maine Water Utilities Association. Sec.Treas., Earle A. Tarr, Winthrop, Me. (Future Meetings Scheduled—Oct. 9—Millinocket; Dec. 12—Mexico).

Sept.—Wahpeton, North Dakota
North Dakota Water & Sewage Works Conference. Sec'y.-Treas., Lloyd K. Clark, Bismarck, N. D.

Sept. 11-13—Ann Arbor, Mich. (Univ. of Michigan Union)
Michigan Conference on Water Purification. Sec.-Treas., R. J. Faust, Michigan Dept. Health, Saginaw, Mich.
(Meeting Jointly with)
Michigan Section A.W.W.A. Sec.-Treas., M. N. Gerardy, 803 Water Board Bldg., Detroit, Mich.

Sept. 16-17—Denver, Colo.
Rocky Mountain Section A. W. W. A. Secretary, R. V. Howe, State Office Bldg., Denver, Colo.

Sept. 18-20—New Castle, Pa. (Castleton Hotel)
Western Pennsylvania Section A.W.W.A. Sec.-Treas., E. P. Johnson, 418 Flannery Bldg., Pittsburgh, Pa.

Sept. 24-27—New York, N. Y. (Commodore Hotel)
New England Water Works Association. (59th Annual Convention). Secretary, Frank J. Gifford, 613 Statler Bldg., Boston, Mass.

Oct. 3-5—Chicago, Ill. (Hotel Sherman)
First Annual Convention
Federation of Sewage Works Associations
Sponsored by
Central States Sewage Works Association
Gen'l Chairman, George J. Schroepfer, Box 3598, St. Paul, Minn. Local Chairman, Dr. F. W. Mohlman, San. Distr. of Chicago, 910 So. Michigan Blvd., Chicago. Sec'y.-Treas. Central States Ass'n., W. H. Wisely, Ill. State Dept. of Health, Springfield, Ill.

YOUR PROBLEM IS SCREENING SEWAGE or SHREDDING SCREENINGS

Sanitary engineers! Sewage plant operators! Anyone who is responsible for the efficient screening and disposal of municipal or industrial sewage should have a copy of this new book which describes Rex Mechanically Cleaned Bar Screens and Rex Triturators! Complete with detailed design data and application information, it is a valuable reference book to keep in your files.

Bulletin 319 also contains reprints of two articles written by experienced sanitary engineers. They describe in detail the benefits of using Rex Triturators and Rex Mechanically Cleaned Bar Screens in their plants.

Whether you're modernizing an old plant or building a new one, you need this fund of information close at hand. Send for your copy now! Address Sanitation Equipment Division, Chain Belt Company, 1610 W. Bruce St., Milwaukee, Wisconsin.

SEND FOR YOUR COPY OF THIS NEW BOOK!

REX **CHAIN BELT COMPANY of Milwaukee**

SANITATION EQUIPMENT

-now the time is almost here

Yes sir, swimmin' time will be along any day now. And as the days get warmer and warmer, there comes a time when a feller's jest naturally got to take his clothes off and go in swimmin'.

You know the feeling. It's as inevitable as the trees turning green. But to some of the older fellows, much as they don't like the idea, this is the time when paint cans come out, and bright new signs are nailed up that say: "NO SWIMMING HERE —POLLUTED WATER!"

Naturally, the 'Board' is not out to spoil anybody's enjoyment, and if the use of "no swimming" signs could possibly be avoided . . .

MR. COMMISSIONER! HERE'S THE ANSWER! You don't need those signs. Just make sure that all effluent from your sewage disposal and waste plants is doubly purified with Solvay Liquid Chlorine! . . . and everybody will stay well and happy. Write for complete information today.

SOLVAY SALES CORPORATION

Alkalies and Chemical Products Manufactured by The Solvay Process Company

40 RECTOR STREET NEW YORK, N. Y.

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SOLVAY

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LIQUID CHLORINE

Oct. 8-11—DETROIT, MICH. (Book Cadillac Hotel)
American Public Health Association. Exec. Sec'y., Dr. Reginald M. Atwater, 50 West 50th St., New York City.

Oct. 8-11—DETROIT, MICH.
American Public Works Association. Exec. Dir., Frank W. Herring, 1313 E. 60th St., Chicago, Ill.

Oct. 14-17—TULSA, OKLA. (Mayo Hotel)
Southwest Section A.W.W.A. Secretary, Lewis A. Quigley, 3320 W. Berry Street, Fort Worth, Texas.

Oct. 16-18—ATLANTIC CITY, N. Y. (Haddon Hall)
Pennsylvania Water Works Association. (45th Annual Meeting.) Secretary, F. Herbert Snow, 507 Telegraph Bldg., Harrisburg, Pa.

Oct. 18-19—ATLANTIC CITY, N. J. (Madison Hotel)
New Jersey Section A.W.W.A. Sec.-Treas., C. B. Tygert, Box 178, Newark, N. J.

Oct. 21-23—LEXINGTON, KENTUCKY (Hotel Lafayette)
Kentucky-Tennessee Section A.W.W.A. Sec.-Treas., H. D. Schmidt, State Dept. of Health, Nashville, Tenn.

Oct. 23-26—LOS ANGELES, CALIF. (Los Angeles-Biltmore Hotel)
California Section A.W.W.A. Secretary, Burton S. Grant, 207 So. Broadway, Los Angeles, Calif.

Nov. 7-8—ST. PAUL, MINN. (Hotel St. Paul)
Minnesota Section A.W.W.A. Sec.-Treas., R. M. Finch, W. & T. Co., 416 Flour Exchange, Minneapolis, Minn.

Nov. 7-8—WILMINGTON, DEL. (Hotel Du Pont)
Four States Section A.W.W.A. Sec'y.-Treas., Carl A. Hechmer, Washington Suburban Sanitary District, Hyattsville, Md.

LITERATURE AND CATALOGS

"Ferrisul" for the treatment of waters, sewages and industrial wastes, is presented in a new Monsanto booklet produced in Monsanto style. The material "Ferrisul" is commercial sulphate of iron, in the ferric state, which has made a place for itself amongst the better known coagulants, and is reputed for its flexibility. Then follows some very lucidly presented comparisons between "Ferrisul" and other coagulants, with actual data in graph form to prove all claims. Such include, wide zone of flocculation, high color and silica and manganese removal properties, flocculation speed at low temperatures, etc. Then follows a chapter on "Ferrisul" in treating sewages and industrial wastes for control of odors, reducing loadings on biological processes, clarification, and reductions in biological oxygen demand. Next comes a discussion of dry-feeding and solution feeding of this free flowing nodular material, proper materials for solution vats, pipe lines, etc. Thereafter, a section on packaging, handling and storage. In short, the new booklet represents the most complete "Story of Ferrisul" yet published. For a copy, write Monsanto Chemical Co., Everett Station, Boston, Mass., or St. Louis, Mo.

"ALCO Steel Pipe" fabricated by electro-welding without girth-seams, is presented in a new American Locomotive Company bulletin which sets forth the attributes of steel pipes in lengths of 22 feet in sizes under 30 inches, and 40 feet in sizes above 30 inches. Tables of weights of pipes of various sizes are supplemented by pictures of representative installations of Alco pipe in the larger sizes, in which the rapidity of laying and jointing the 40 ft. lengths is emphasized. For a copy of bulletin No. 1021, write "Alco" Products Div., American Locomotive Co., 30 Church St., New York City.

"W & T Hypochlorinators" is a new 8-page illustrated booklet published by Wallace and Tiernan Co., which describes their simple and inexpensive solution feeder. It emphasizes the adaptability of W & T Hypochlorinators to small water supplies in a section titled, "How it Works." Listed features of the unit include ease of installation, simplicity and economy of operation, durability of materials. Typical installation sketches show

how W & T Hypochlorinators may be installed either in pump discharge or in pump suction,—operating as manual or automatic units. "W & T Hypochlorinators," (publication 357), may be obtained by writing Wallace & Tiernan Co. Inc., Newark, N. J.

"The M & H Line" of water and sewage works equipment and accessories is presented in probably the most comprehensive catalog ever produced by M & H Valve and Fittings Co. Certainly there has been no more effective presentation by M & H of its line which embraces Gate Valves (A.W.W.A. Spec. 2″ to 30″); Valves up to 48″ (Hydraulically or Gear Operated); Low Pressure Gates; Square Bottom Valves; Tapping Valves and Sleeves (all sizes); Cutting-in Tees; Floor Stands; Swing Checks (bronze mounted); Fire Hydrants (A.W.W.A. Specs.—Compression Type); Shear Gates and Mud Valves; Flap Valves; C. I. Fittings and Specials. Each item is illustrated by a cut-away view, with tabulated specifications and dimensions, and suggested methods of ordering are presented. For a copy of Catalog 34 address, M & H Valve and Fittings Co., Anniston, Alabama.

"Cochrane Zeolite Softeners" are described in a well written illustrated bulletin from Cochrane Corporation. The process is explained and data in tabular form, supplemented by charts, are helpful to the designing engineer or prospective purchaser of softening equipment for any particular installation. For bulletin No. 2860, write Cochrane Corporation, 17th and Allegheny, Philadelphia, Pa.

"Dorrco V-Type Pumps" are presented in a new bulletin from The Dorr Co., Inc. Entirely new, these units are offered as an improved type of diaphragm sludge pump, the length of stroke (capacity) of which may be changed at will during operation. Other improvements over the older type of Dorrco Diaphragm Pumps are their ability to operate against small pressure heads and, more importantly, their much lower headroom requirement. Impressive is one illustration which pictures the new pump and a gawky predecessor of the same identical capacity, side by side. In this, trimness and compactness of the new unit is emphasized. Other attributes listed for the V-Type design are higher mechanical efficiency, longer diaphragm life, and the fact that no gear-motor is required. For a copy of Bulletin 5001, address The Dorr Co., 570 Lexington Ave., New York City.

"Cochrane Gas Meters" are mechanical type meters for flow measurement of gas pressures of 2 to 6 inches of water head. Details of design and method of operation are fully explained in bulletin No. 2089. For a copy write Cochrane Corporation, 17th and Allegheny, Philadelphia, Pa.

"The Book of Pipe Protection" has issued in its fourth edition. It is a production of General Paint Corporation and describes the Hill-Hubbell processes of Mill Coating-and-Wrapping and Lining of steel pipes. Chapters have been re-written to bring them up to date. The illustrations picturize essential mill operations and show typical joint making in the field. Something of the history of the Hill-Hubbell processes since 1906, employing Biturine Enamels, is told. Then follows suggested specifications, including methods of handling and laying the protected pipes, and field jointing operations. At the end is a listing of 5 leading steel pipe fabricators equipped to produce Hill-Hubbell protected pipes, and a complete presentation of specification—prices, terms, trade practices and other pertinent buyer information. The number of coatings and wrappings run from 5 to 8 and there are two lining coatings of specified materials. The producer requests that all third edition copies of "The Book of Pipe Protection" be discarded for the

Don't Let Corrosion Get Your Pipe!

COAT IT!
For more than 25 years, engineers and operators have recognized the fact that corrosive soil action quickly breaks down most types of ferrous pipes. It takes a tough, durable coating to assure long life and low-cost service.
WRAP IT!
Soil stress can cause serious damage even to a rugged coating. Unless the coating is properly reinforced or shielded with a lasting protective wrapping, maintenance and replacement charges may easily become expensive problems.
Use the BEST wrapping ... ASBESTOS!
Authorities agree that only asbestos pipe-line felts give positive assurance of long life and low upkeep. Be sure you get full protection by using J-M Felts. They're made of inorganic, non-tubular asbestos fibers . . . cannot support capillary action. Their unusual strength and durability prevent distortion or abrasion of the coating. And they effectively resist all forms of corrosion . . . keep maintenance at permanently low figures.

FULL DETAILS will show you how J-M Asbestos Felts add years of life to pipe lines under any service conditions. Ask for Brochure DS-375. It also tells you how to obtain pipe mechanically-wrapped by mill, shop or field application. Johns-Manville, 22 E. 40th St., New York, N. Y.

Johns-Manville
ASBESTOS PIPE-LINE FELTS

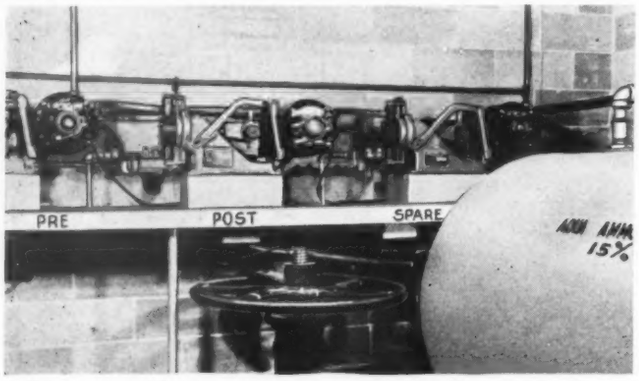
DID YOU SEE OUR FUN HOUSE AT KANSAS CITY!

Many of our friends stopped in, had a little fun with us, and went away with a story of the latest in %Proportioneers% Chemical Feeder development. It's an interesting story!

AMM-O-FEEDER SAVES MONEY

"We are saving $105 per month by feeding aqua ammonia with Amm-O-Feeder, instead of using anhydrous"

—thus writes C. J. Lauter, Chemical Engineer, Dalecarlia Filtration Plant, Washington, D. C., who has proof in actual figures from that plant (which formerly used anhydrous ammonia). At McMillan



Amm-O-Feeders at Dalecarlia Filter, Wash., D. C.

Filter, just starting the use of aqua, Mr. Lauter expects a similar saving. *You should investigate*—the chemical costs less, the feeder costs less—there is no limit to the size of the plant which can save by using aqua; in fact, the larger the plant the larger the savings.

XSDeCHLORINATION

(excess and de-chlorination). High chlorine dosage (beyond the "burn-point" in the chlorine "residual-versus-dosage" curve), i.e., superchlorination—is becoming widely known as a means of taste and odor control. The excess chlorination oxidizes the taste producing organic matter. Chlor-O-Feeders are useful, first, for feeding the excess chlorine, and, second, for feeding sodium bi-sulphite for the de-chlorination which is frequently used to remove chlorinous taste.

"A Fish Story for Water Works Superintendents"

—and operators of sewerage plants and swimming pools! Bulletin "MAR" contains chemical feeding news that is of vital interest to you. Send for your copy today.

% PROPORTIONEERS Inc. %

9 NO. CODDING STREET PROVIDENCE, R. I.

revised edition. For a copy address, Hill, Hubbell Div., General Paint Corp., Cleveland, Ohio.

"Graver Sub-Surface Filtration Systems" are described and illustrated in a new bulletin from Graver Tank and Mfg. Co. of Chicago, The Graver System makes use of the lantern shaped (conical) filter screens patented by Ira H. Jewell, who has long been identified with water filtration developments. The basic claim for the system is an increase in filter capacity which results when equipping sand filters with the system. Furthermore, in sand bed washing the system serves to produce a "top-wash" of the bed and is claimed to result in wash water economy and assured freedom from mud-balls and other bed troubles. In the process of filtering, a 50% increase in filtering rate (namely 3 gals./sq. ft./min.) is obtainable with the same loss of head. In such increase it is stated that the quality of effluent is not adversely affected and economy results. For a copy of "Sub-Surface Filtration Systems," write Graver Tank and Mfg. Co., East Orange, Ill.

"Koppers' Gate Valves" are presented in a folder just issued by the Bartlett Hayward Division of Koppers Co., describing low-pressure all-iron gate valves for water, gas, sewage and power plants and other industrial applications. A table gives complete specifications of valves from four inches to 48 inches in size. Shown, are details of construction and operation. Valves are equipped with bevel and spur gears, chains, hand wheels, dust shield and indicators. For a copy of bulletin No. 608, write Bartlett Hayward Div. of Koppers Co., Baltimore, Md.

"Glassed-Over Treatment Plants" is the title of a folder from Lord and Burnham Co. which is devoted to small sewage treatment works covered partially if not wholly by glass enclosures, for the purpose of preventing the travel of odors from the plants on warm, humid days or nights. The folder points out that of the 27 municipalities along the Hudson River recently constructing small sewage treatment plants, 20 plants have glass covered sludge beds. Some also have glass covers over the sedimentation units, for the purpose of controlling odor travel from the plant and, at the same time, enhancing plant appearances. For a copy of "Glassed-Over Treatment Plants" write Lord and Burnhame Co., Irvington, New York.

Jack Lift Trucks and Skid Platforms by Lewis-Shepard Corp., are presented in a new profusely illustrated and complete 56 page catalog, which denotes 25 years of materials handling service by this firm. Of particular interest to readers of this magazine are the sturdy Jack-Lift Trucks and skid platforms useful in handling and storing packaged water works and sewerage chemicals or equipment. Also presented is a variety of 2 wheel hand trucks for general utility trucking service. For a copy of Catalog No. 21 write Lewis-Shepard Sales Corp., Watertown, Mass.

Parker Tube Fabricating Equipment is subject of a bulletin from The Parker Appliance Co. of Cleveland. Amongst the items are tube bending machines and hand benders for the smaller diameter copper tubing; tube flaring and fabricating tools, cutters, etc. For a copy of Bul. No. 40E. write The Parker Appliance Co., 17325 Euclid Ave., Cleveland, Ohio.

G.-E. Thrustor Operated Valves are described in a leaflet which explains and illustrates fulcrum type valves equipped with a Standard Thrustor for closing and opening single or double seated valves in sizes 1 to 10 inches. These valves are offered for steam, water, gas, brines, and also for chlorine gas. For a copy of leaflet GEA.-1569 B, describing Thurstor Operated Valves, address General Electric Co., Schenectady, N. Y.

revised edition. For a copy address, Hill, Hubbell Div., General Paint Corp., Cleveland, Ohio.

"Boiler and Tank Accessories" is probably the first complete catalog ever to be devoted to accessories for boilers and pressure tanks. It is produced by The Steel Improvement and Forge Company of Cleveland, Ohio and presents the complete line of Diamond-S accessories in a manner which renders simple the matter of referring to any type of accessory for complete purchasing information. The catalog also contains much technical information and data of value to engineers and purchasing agents. Hydrostatic test pressure curves, and their interpretations, are given with supplementary technical data. For a copy of "Boiler and Tank Accessories," write The Steel Improvement & Forge Co., Addison Road and 62nd St. (East), Cleveland, Ohio.

"General Purpose Turbines" are covered in a new illustrated 28 page booklet which describes Westinghouse general purpose impulse turbines for condensing or non-condensing service. The sizes of these turbines, known as type C, cover the range from 5 to 1500 horsepower and inlet steam pressures up to and including 600 pounds and 750 degrees. Complete descriptions of the turbines are given with emphasis on the scheme of "Dual Protection," incorporated to prevent accidents or service outages due to overspeed. Mechanical parts are outlined, explained and illustrated by means of marked pictures. Special features are treated similarly in another section of the booklet. Detailed dimension sketches appear in the rear, and general material specifications are tabulated in easy readable form and include all necessary information needed by the potential customer to select the turbine most suitable to his deeds. A copy of booklet B-2230 can be secured from the Westinghouse Electric and Mfg. Co., (Dept. 7-N-20) East Pittsburgh, Pa.

"Cochrane Multi-port Drainers"—are large capacity condensate traps with a feature which renders the flow of condensate therefrom continuous rather than intermittent. The bleed valve is a completely balanced rotary type valve, which gradually opens and closes with changes in the float position within the regulating chamber. In addition to its use on steam lines this unit may have a place in the automatic removal of condensate from sludge gas lines or air lines at sewage treatment plants. For a copy of Publication 2925, write Cochrane Corporation, 17th and Allegheny Ave., Philadelphia, Pa.

"Hypochlorite Pumps" are described and illustrated in a leaflet from Milton Roy, of Philadelphia, manufacturers of chemical pumps and proportioners. The capacities of the Milton Roy Hypochlorite Pump is from one to 10 gallons per hour, these units being designed to introduce chemical solutions against pressures up to 100 lbs. The dosage change is secured by altering the length of pumping stroke of the motor driven displacement piston. For a copy of "Milton Roy Hypochlorite Pumps," write Milton Roy, 3160 Kensington Ave., Philadelphia, Pa.

De Laval Centrifugal Blowers and Compressors are presented in a new comprehensive handsomely produced catalog of 52 pages. The construction of centrifugal blowers and their characteristics is followed by methods of driving such units and speed governing. Then comes a chapter on compression and physical properties of gases, including air, and formulas, constants employed in compression work and friction losses in pipe lines conveying gases or air. For a copy of Catalog F. write DeLaval Steam Turbine Co., Trenton, N. J.

Ferric Chloride

(Anhydrous & Liquid)

Supreme sewage coagulant for

Sludge Dewatering
Raw Sludge
Raw Activated Sludge
Digested Sludge
Mixed Sludge
Coagulation
Raw Sewage
Settled Sewage
Industrial Sewage
Mixed Domestic and Industrial Sewage

SINCE pioneering in the production of liquid Ferric Chloride for use in Sewage disposal, Pennsylvania Salt Manufacturing Company has continued to lead in the development of economical and effective methods of using this product.

We will gladly advise you on all chemical sewage treatment problems.

PENNSYLVANIA SALT MANUFACTURING COMPANY
Est. 1850
Widener Bldg., Philadelphia, Pa.
New York · Chicago · St. Louis · Pittsburgh · Tacoma · Wyandotte

PENNSYLVANIA SALT
MANUFACTURING COMPANY
Chemicals

EQUIPMENT NEWS

Two New Safety Units for Sewage Plants

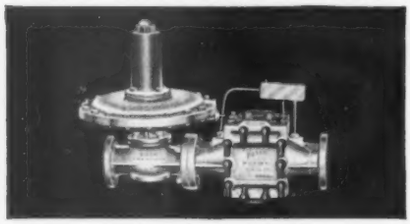


Fig. 440—Pressure Relief Regulator and Flame Trap.

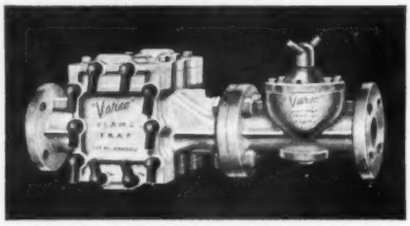


Fig. 450—Flame Trap and Thermal Shut-off Valve.

● The Vapor Recovery Systems Company of Compton, California, announces two new safety units for use in gas lines of sewage treatment plants.

One (Fig. 440) consists of a sensitive diaphragm-operated pressure relief regulator and flame trap which is fully self contained and includes a positive thermal shut-off valve.

The other (Fig. 450) consists of a flame trap and thermal shut-off valve for gas lines serving gas utilization equipment.

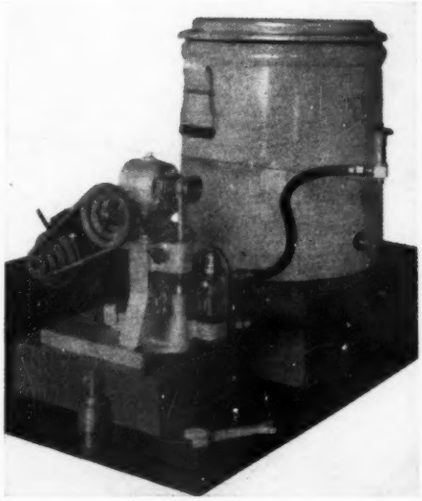
Both are manufactured of pure aluminum which it is claimed is non-corrosive in sewage gas.

A patentable feature is the extensible flame trap element which greatly simplifies inspection and maintenance.

Both units are designed for straight line flow which simplifies piping connections.

A new "Varec" Sewage Gas Control Equipment Catalog is also announced and will be sent to any one requesting a copy. The address is The Vapor Recovery Systems Co., Compton, Calif.

Improved Chemical Feeder by Wilson



● Wilson Chemical Feeders, Inc., of Buffalo, N. Y., are offering the improved Type RC-MD Chemical Solution Feeder.

The compact feed unit is a motor driven positive displacement pump type feeder which is designed for operation against pressures up to 150 lbs./sq. in. and is available as an automatic proportioning or manual control unit. This unit may also be powered by a miniature ½ H.P. gasoline engine equipped with 4-stage pulleys for major dosage changes. Refinements in feed adjustment of length of pump plunger travel.

Other features are the visible valves and feeding rate; and the ease with which the valve assembly may be taken down and reassembled.

For Bulletin 889, more completely describing this unit, write Wilson Chemical Feeders, Inc., Buffalo, N. Y.

Reilly COATINGS PROTECT ALL METAL SURFACES

REILLY Primer and Pipe Enamel for water, sewerage and oil pipe lines, specified by leading engineers in all sections of the country, are supplemented with other protective coatings for stone, concrete and for metal which is exposed to atmosphere, corrosive gases and vapors.

REILLY COLD APPLICATION COATING (CA) NO. 40

This coating, which is a liquid at normal temperatures, may be applied with brush or spray. It is a deep black durable paint which adheres firmly to all metal surfaces, such as tanks, structural steel, and exposed metal. When properly applied it will not crack, check or peel, and will safely withstand wide temperature variation. Dries thoroughly in 24 hours. Further information on request. Address Dept. E-30.

REILLY TAR & CHEMICAL CORPORATION
Executive Offices: Merchants Bank Building, Indianapolis, Indiana
2513 S. DAMEN AVENUE, CHICAGO, ILLINOIS 500 FIFTH AVENUE, NEW YORK, N. Y. ST. LOUIS PARK, MINNEAPOLIS, MINN.
FIFTEEN · PLANTS · TO · SERVE · YOU

Sewer and Drainage Pipe of Conduit Fibre (Known as Orangeburg Sewer Pipe)

● We have just learned of the introduction of a dense, resistant and flexible water-proof fibre conduit into the sewerage and drainage field. The new sewage and drainage pipe, now available in sizes up to 8 inch diameter, is being fabricated by the long established (1893) producers of fibre electrical conduit, The Fibre Conduit Co. of Orangeburg, N. Y. The product has in consequence been named Orangeburg Sewer Pipe.

We understand that fibres pipes of 4" and 6" sizes, produced in the Orangeburg factory, have actually been in service as drainage or sewage lines continuously for 16 to 30 years, the longest period having been in connection with domestic sewage. Having a wall thickness of 0.4 inch and an earth cover of 4 ft., this 30 year old pipe line was recently dug up and found to be out of round only ¼ inch. The joints were found tight, the shape slightly oval and the interior walls free of deposits or biological growths. Also in drainage work Orangeburg Pipe has been satisfactorily employed for acid mine drainage and factory wastes (alkali and acid) and also where ground settling has resulted in pronounced pipe bending which only steel pipe could have withstood without failure. In oil fields the fibre pipe has been used for transporting highly corrosive salt water and destructive sulphuretted waters.

Orangepurg Pipe is a coal-tar pitch impregnated product which has a 48 hour water absorption index of less than 2%. Tests reveal carrying capacities of the order of C-150 in the Hazen-Williams formula and according to the Manning or Kutter formulae a coefficient of roughness (n-value) of under 0.009.

Orangeburg Pipes being of such light weight material are produced in 5 and 8 ft. lengths. They are jointed merely by inserting a machined spigot end into a machined receiving end and driving home, is secured bottle tight joints under 50 lbs. pressure. For fittings cast-iron is employed; the bends are of fibre conduit. The new fibre pipes also have potentialities for use as filter underdrains (water or sewage), air lines, etc., and wherever flexibility and permanency is of importance.

We are informed that Orangeburg Pipes are under production in 4-5-6 and 8-in. diameter and in time 10 and probably 12-inch pipes will be under production. We also understand that arrangements can be made for securing a reasonable number of these new pipes, on a cooperative trial and demonstration basis.

An elightening brochure, outlining "The Development and Outlook for Orangeburg Sewer and Drainage Pipes" and giving specification data, may be secured by writing The Fibre Conduit Company, W. & S. Div., Orangeburg, N. Y.

THE ROYER

Helps City Funds Do Double Duty!

Americaville has found a way to make operating funds go farther. Their sewage treatment works that used to spend good round dollars to incinerate and bury sewage sludge and their park board that used to spend more cash to buy fertilizer now jointly own a Royer.

The Royer disintegrates partially dried sewage sludge, further drying it, shredding it to pea size ideal for mixing with soil or compost, or for direct application to lawns, shrubs and flower beds. The sewage works eliminated incineration costs and the park board gets quality fertilizer at low cost.

Furthermore, the park board uses the Royer between times to shred and mix compost for top dressing and to mix in sewage sludge and concentrated fertilizers where needed. Sticks, stones and trash are removed by the Royer, providing protection to lawn mowers. Too, they are used to mix cinders, sand and clay for paths and walks and tennis courts.

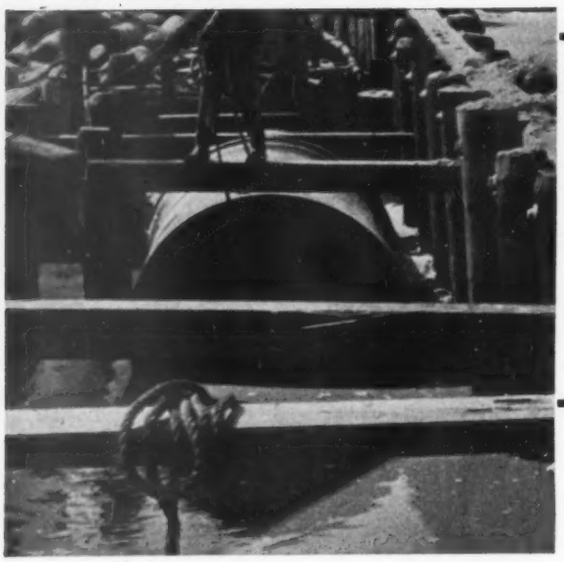
Thus, with a small investment, Americaville is stretching tax dollars — making them do double-duty.

Read how municipalities everywhere are profiting with Royers — write for "Turn Sludge Disposal Costs into Worthwhile Profits" — 6 pages of facts that you should know.

ROYER FOUNDRY & MACHINE CO.

170 Pringle St., Kingston, Pa.

This New Jersey sewage plant uses a Royer to shred sewage sludge, converting it into readily marketable fertilizer.



84" pipe—Spring Lake, N. J.

FLANGED PIPE

FLEXIBLE JOINT PIPE

BELL & SPIGOT PIPE

SPECIAL CASTINGS

SHORT BODY BELL & SPIGOT SPECIALS

Large stock enables us to make prompt shipments.

CAST IRON PIPE

SIZES 2" TO 84"

Warren Foundry & Pipe Corp.

11 Broadway, New York

Warren Pipe Company of Mass., Inc.

75 Federal St., Boston

LEADITE

The Pioneer Self-Caulking Material for C.I. Pipe

One User says:

"WATER LINES LAID WITH LEADITE JOINTS"

4"	6,171 ft.
6"	714,973 ft.
8"	234,723 ft.
12"	121,211 ft.
16"	7,986 ft.
20"	45,623 ft.
24"	4,952 ft.
30"	11,444 ft.
36"	7,476 ft.
48"	34,519 ft.
Total	1,189,078 ft.

Widely used and endorsed for over 35 years . . .

THE LEADITE COMPANY

Girard Trust Co. Bldg., Philadelphia, Pa.

No Caulking

A New Idea In Water Practice

✦

Prevent excess aquatic plant life in feeder lakes with

BENOCLOR 3.

Weeds that never grow cannot deplete oxygen late in the summer.

✦

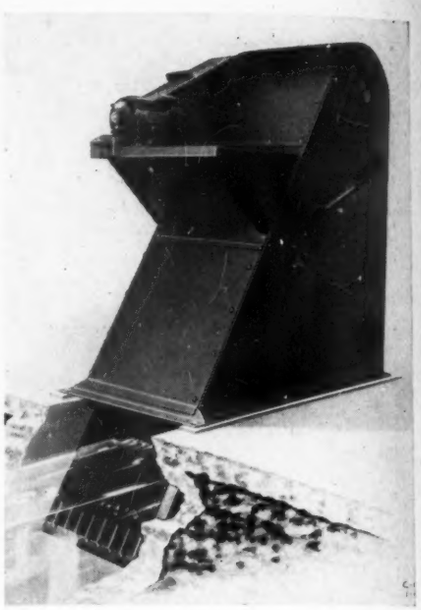
Let us give you full information

✦

CLOROBEN CORP.

90 Forrest St. Jersey City, N. J.

New Rex Screen and Grit Collector for Small Plants



• Recognizing the need of mechanical equipment designed and built particularly for the small sewage plant, the Chain Belt Co. has developed a mechanically cleaned bar screen, grit collecting equipment, and a conveyor sludge collector especially for this service. The first of these three new units is here pictured.

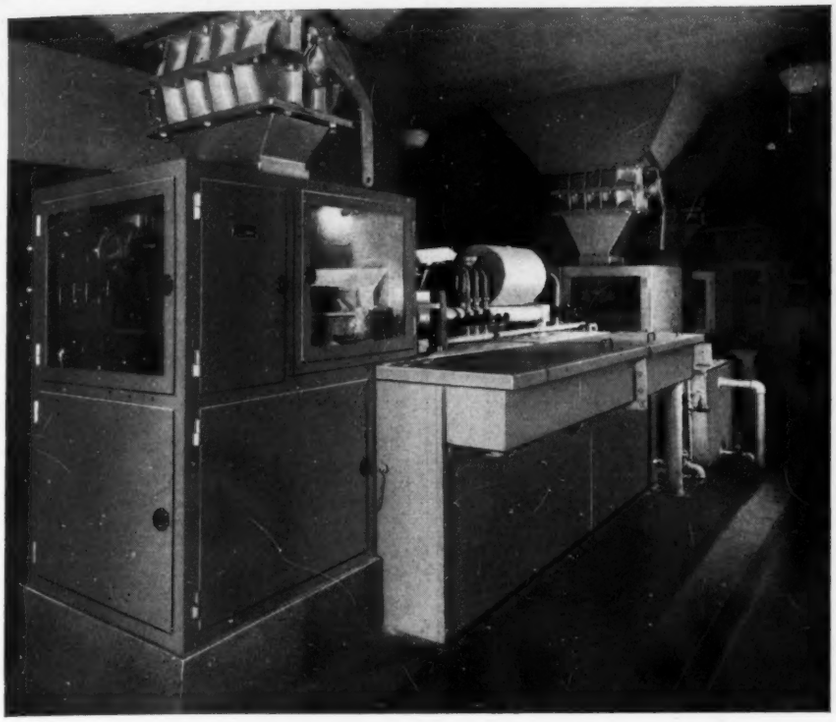
This neatly and completely-housed replica of the large Rex Mechanically Cleaned Bar Screen is built as an integral, self-contained unit. It is of simple, rugged design and is easily installed in new or existing channels with a maximum width of 3 feet and a maximum depth of 5 feet. The screen may be used with or without the Rex Triturator. The small sewage plant can now replace existing hand-cleaned bar racks with this automatic unit at reasonable cost.

A new grit collector unit developed by the Chain Belt Company also puts mechanical grit removal within the reach of the small plant budget.

The new Rex Grit Collector and Washer is suitable for flows up to about 4 M.G.D. and is installed in a simple concrete channel with all machinery above the channel enclosed in a neat housing. Careful hydraulic design and grit washing by an ingenious recirculation arrangement, is guaranteed to produce grit of good quality for easy disposal.

Descriptive literature and further details may be had by writing the Sanitation Division, Chain Belt Co., Milwaukee, Wis.

Omega Gravametric Feeder Improved

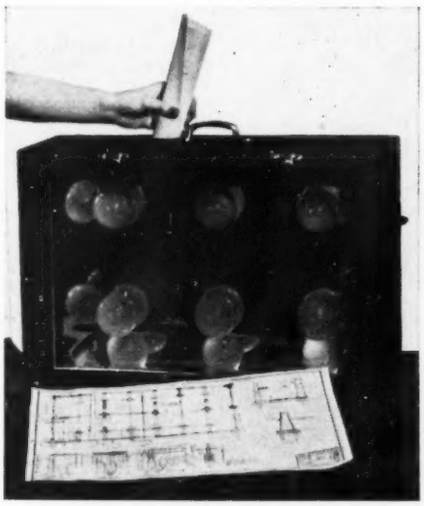


● Omega Machine Co. announce certain improvements to their well known Belt Type Gravametric Feeder. Here pictured is an installation of the improved feeders which are actuated from Venturi meters to provide automatic proportional feed.

The most obvious improvement is that of the semi-concealed illumination within the cabinets and plate glass doors to facilitate observation, inspection and supervision of the feeders. The improved appearance of the units is self-evident and the operation of well known Omega Rubber Wedge and Oscillator Control Unit is clearly visible at all times, and the same is true of the feeding tray and the travelling weigh-belt. The control of the feed mechanism by the scales has been simplified but at the same time made more positive.

New catalog pages by Omega illustrate and describe the improved Visible Gravametric Feeder. For a copy write Omega Machine Co., 4010 Penn Ave., Kansas City, Mo.

Elpro Portable Printer



● The new Elpro Portable Printer, just announced by the Ozalid Corporation of Johnson City, N. Y., is a reproduction unit, designed to use positive printing, and dry developing with Ozalid sensitized papers and cloths. It is useful in reproducing engineering drawings, letters, reports, maps; in fact, any pencil or ink lines, typewritten or printed matter appearing on one side of a reasonably translucent sheet.

The light source consists of six specially developed lamps. The case is finished in attractive gunmetal, and a highly polished aluminum reflector assures uniform light distribution over the printing surface. A new feature is a dry developing chamber conveniently located behind the metal reflector; thus, utilizing the heat generated by the lamps to vaporize the developing agent. An additional feature is a time switch, which allows the operator to regulate the length of exposure without guess work.

Being designed as a portable unit, the Elpro Printer can be used either in the office or in the field. Since no developing solutions are used, no washing, fixing or drying is required. Prints can be conveniently made at a moment's notice by any employee. The cost of making Ozalid prints with the Elpro Portable Printer is said to be but a fraction of the cost of making such reproductions by other photocopy methods.

For further details of this interesting unit, and prices, write Ozalid Corp., Ansco Road, Johnson City, N. Y.

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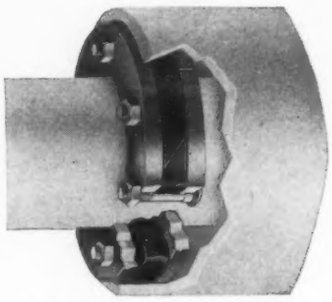
Philadelphia Gloversville, N. Y.

Dresser Casing Bushings



● A practical answer to the problem of sealing the ends of a protective casing through which a pipe-line runs, is found in the new Dresser Casing Bushing. Also the device may be used for sealing smaller pipes into larger ones. Consisting of two halved steel rings with a rubber-compound gasket bolted between them, this Bushing is said to be easily assembled around the smaller pipe and slipped into the ends of casing or larger pipe. The illustration tells the story; as the bolts are tightened, the gasket expands in two directions—outwardly against the inside of casing and inwardly against the outside of the pipe, making a tight seal against both. Casing Bushings are recommended for any line where protective casing is used, as under a railroad track, highway, embankment; across a swamp, canal, irrigation ditch, or stream. The scheme may also be used as a means of securing air-space insulation to prevent heat loss or freezing.

A number of advantages are listed by the manufacturer for the new Casing Bushing. It is said to seal out dirt, debris, weeds, small animals, and corrosive water from entering casings. Pipe life will be prolonged, because pipe is kept dry and clean. In the casing the pipe line "floats." Vibration and shock from passing trains and traffic (ordinarily relayed to pipe) are absorbed by the resilient rubber gasket. It centers the pipe-line in casing—pipe does not rest on bottom of casing where corrosion may develop and coating be scraped off. Quickly and easily installed by one man using only a wrench, the Casing Bushing is declared to eliminate crew back-tracking; open trench; and costly sealing methods and materials.

The Style 83 Casing Bushing is offered by the maker in four types to meet varying field conditions. Types 1 and 2 take care of all ordinary installations where there is no pressure condition between pipe and casing. Types 3 and 4 are designed for installations where such internal pressures may occur, or where the line is subject to heavy ground settlement or to strong currents or undertows (on subaqueous lines). Any size can be furnished.

A two-page catalog (form 402) gives complete information, specifications, sizes, and list prices. For a copy write Dresser Manufacturing Co., Bradford, Penna.

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The Perfected Method for Making SEWER PIPE JOINTS OF CEMENT

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Potentiometer—Pyrometer

● A fundamentally new type of potentiometer-pyrometer for measurement of temperatures by thermocouples has been announced by J-B-T Instruments, Inc., of New Haven, Conn.

The new instrument is especially designed for portable use and in testing permanently installed temperature measuring and controlling equipment. The manufacturer claims that less balancing and less effort is required to operate this potentiometer than any other now existing.

Known as Model 70-PO, for which patents are pending, the instrument has amongst several features the following:

(1)—Weighing under 5¼ lbs. is truly portable; (2)—withstands vibrations and adverse conditions of ambient temperature; (3)—Requires no standard cell and operates on an ordinary flash-light cell; (4)—Is accurate to ½ of 1% of total scale deflection; (5)—Requires no adjustment to compensate for changes in room temperature; (6)—Being independent of thermocouple resistance, the use of small thermocouples is permissive where larger elements would be too slow, too fragile or oversize, and replacements are easily made.

Another, and decided advantage (possibly the greatest) is that less balancing is required. Once balanced and adjusted for any temperature above zero the new J-B-T pyrometer requires no further balancing operation and is thereafter read as a deflection instrument.

The Model 70-PO case is of mahogany, measuring 6½x7½x5 inches, with slip-hinge cover in place and closed. The panel is of engraved Bakelite. The instrument, with leather carrying handle, weighs something under 5¼ pounds. For switchboard flash mounting an aluminum can be had.

For literature and prices write J-B-T Instruments, Inc., 441 Chapel St., New Haven, Conn.

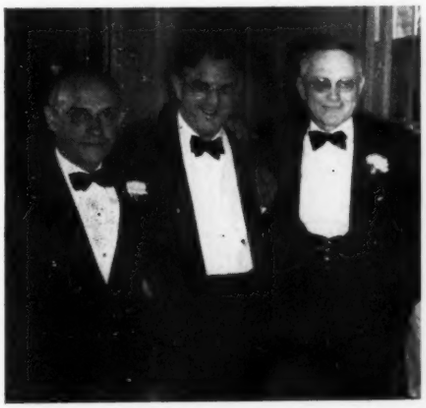
WITH THE MANUFACTURERS

Wallace & Tiernan Honor Orchard

● William J. Orchard, general manager of Wallace & Tiernan Co., Inc., and associated companies, was guest of honor at a banquet at the Waldorf-Astoria Hotel, New York City, on April 15th, tendered him by a number of his associates in recognition of his 25 years service with Wallace & Tiernan Co.

Among the many gifts to Mr. Orchard was a book containing souvenir photographs of his industrial career and the signatures of the more than one thousand employes of Wallace & Tiernan Co., and a diamond studded 25 year service pin, presented to him by Mr. M. F. Tiernan, president of the organization.

Mr. Orchard, who deserves a deal of credit for the successes of his company, is an honorary member of the American Water Works Association, Fellow of the American Public Health Association, member of the Board of Control of the Federation of Sewage Works Associations, Past President of the Water Works Manufacturers Association and for several years has been chairman of the Convention Management Committee of the latter organization. In short, he is what is aptly termed a "Go-Getter," and a highly appreciated citizen, in general.



"Fred Wallace (The Inventor); "Bill" Orchard (The Master Salesman and Manager); "Mike" Tiernan (The President who started with nothing more than an idea.)

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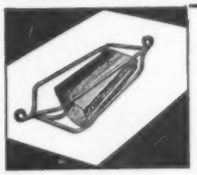

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● If prizes had been awarded for the most novel idea in arranging exhibits at the Kansas City Convention of A.W.W.A., % Proportioneer's % of Providence likely would have walked off with the big prize. The above picture is what brought in the curious passerby to see Proportioneer's exhibit.

Presaging World's Fair days, again just around the corner, showman Corydon, Proportioneer's president, conceived this idea of "bringing 'em in" to see his "Little Red Pumps" by the midway route. Judging from the visitor's register inside the scheme was a success.

Chain Belt Appointments

● Chain Belt Co., which has 22 district sales offices throughout the country for the sale of its line of Rex equipment, announces the following changes in District Managers.

Thomas E. Cocker has been appointed manager of the Detroit office, succeeding G. A. Gunther. Mr. Cocker has been with the company since 1921 and has served as district manager of both the Cleveland and Buffalo offices.

Mr. Klemme, who becomes manager of the Buffalo district office, has been with the company since 1935 serving in both the engineering and sales departments.

R. S. Peare Heads "G. E." Publicity

C. H. Lang Becomes Manager of Apparatus Sales

● Robert S. Peare, president and general manager of the Maqua Co., a large printing and engraving concern affiliated with General Electric, has been named manager of the publicity department of the General Electric Co., succeeding Chester H. Lang who becomes manager of apparatus sales for the company.

Chester H. Lang, manager of General Electric's advertising and sales promotion activities since 1932, has been named manager of apparatus sales and vice chairman of the Company's Apparatus Sales Committee. Since 1932 he has held the position of Manager of Advertising.

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This is a sturdy, dependable heavy duty feeder.
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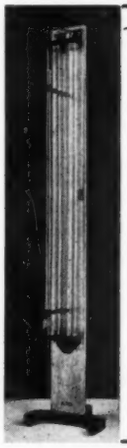

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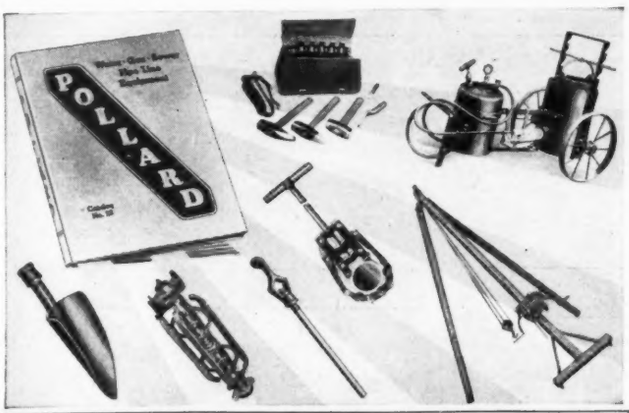

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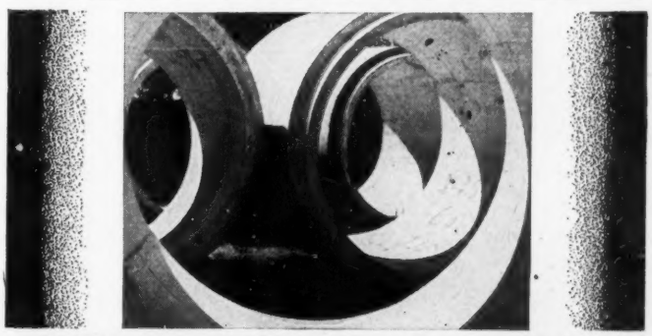

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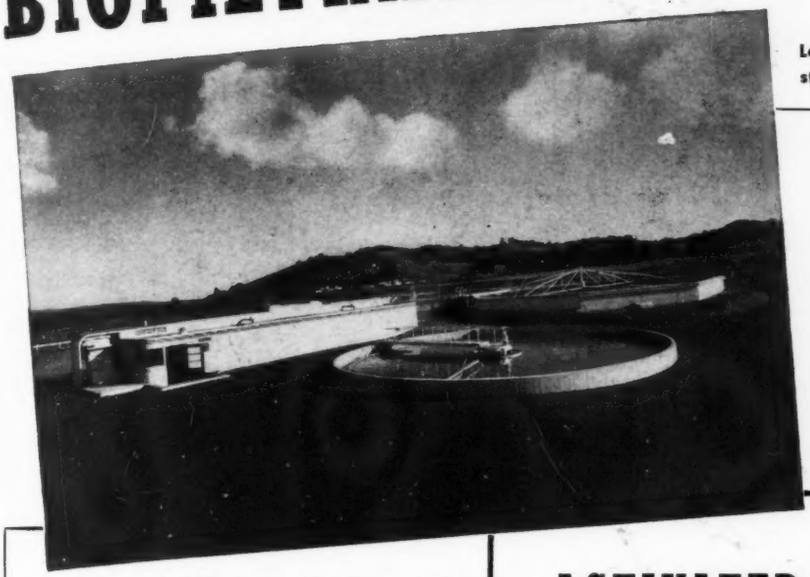
BIOFILTRATION *at* PETALUMA



Left: Biofiltration System at Petaluma, Cal. Primary stage only shown; secondary behind building.

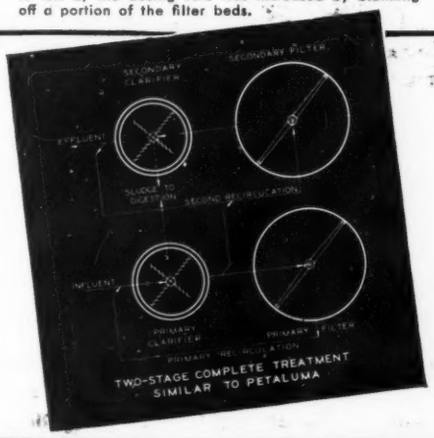
Advantages of Biofiltration System Compared with Standard Trickling Filter Practice

- Uniform final effluent regardless of feed fluctuations
- Filter loadings up to 10 times normal
- Shallow filters—3 ft. media depths
- Installed costs 25 to 35 percent less
- Operating costs 30 to 40 percent less

Two-Stage Biofiltration at Petaluma, Cal.

Test No.	1	2
Flow—M. G. D.	.503	.500
Dosing Rate Raw—M.G.A.D.	5.05	10.6
Total—M.G.A.D.	17.2	37.1
Sus. Solids—PPM		
Raw	424	462
Final	33	43
Removal—percent	92.3	90.7
B.O.D.'s—PPM		
Raw	576	521
Final	14	28
Removal—percent	97.6	94.6
Raw B.O.D. Loading		
Lbs/cu yd/day	2.47	4.78

Each test represents a week's average results.
Analyses run daily on 24 composited houtly samples.
In test 2, the dosing rate was increased by blanking off a portion of the filter beds.



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ACTIVATED SLUDGE RESULTS *at* LESS THAN TRICKLING FILTER COSTS

★ At Petaluma, California, the total plant cost, excluding the pumping station, was $101,000 per million gallons of design capacity—25 to 35 percent less than a Standard Trickling Filter installation. Yet the results obtained are directly comparable with Activated Sludge practice.

The Petaluma and other installations of the Biofiltration System have demonstrated the advantages cited in the box above. Results tabulated at the left show that high B. O. D. reductions are readily obtained, even with strong sewages.

The Biofiltration System, marketed by us, is represented by 14 operating installations and by 7 additional units now under contract. By recycling the filter discharge back to the clarifier, it makes it possible for the first time to control the trickling filter operation.

● *Why not write for a complete technical report and operating data on Biofiltration—or better still, ask one of our engineers to call and explain it in person?*

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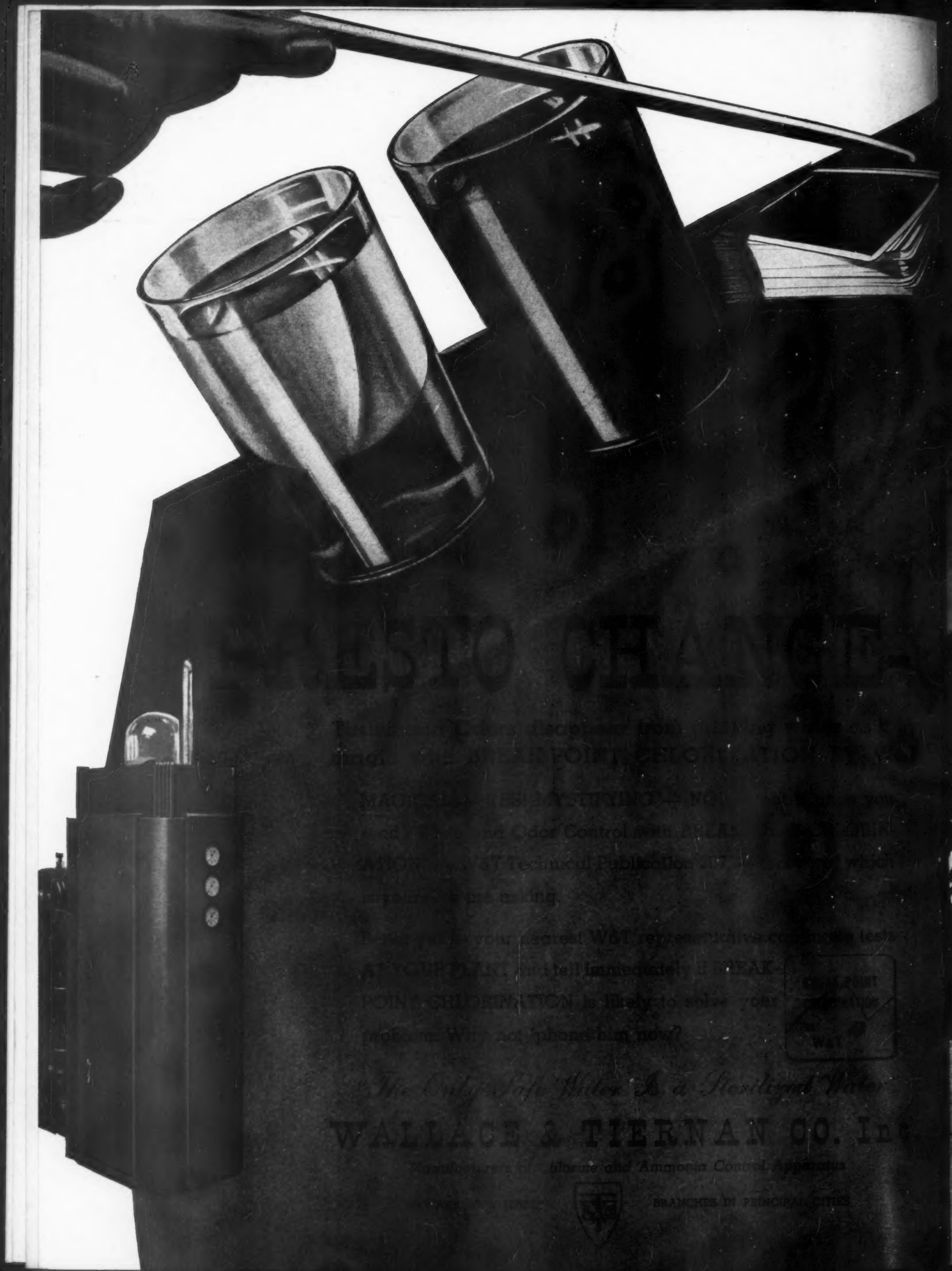
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